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UNE 8, 1942
OLUME 31, No. 12

AMERICAN DYESTUFF REPORTER

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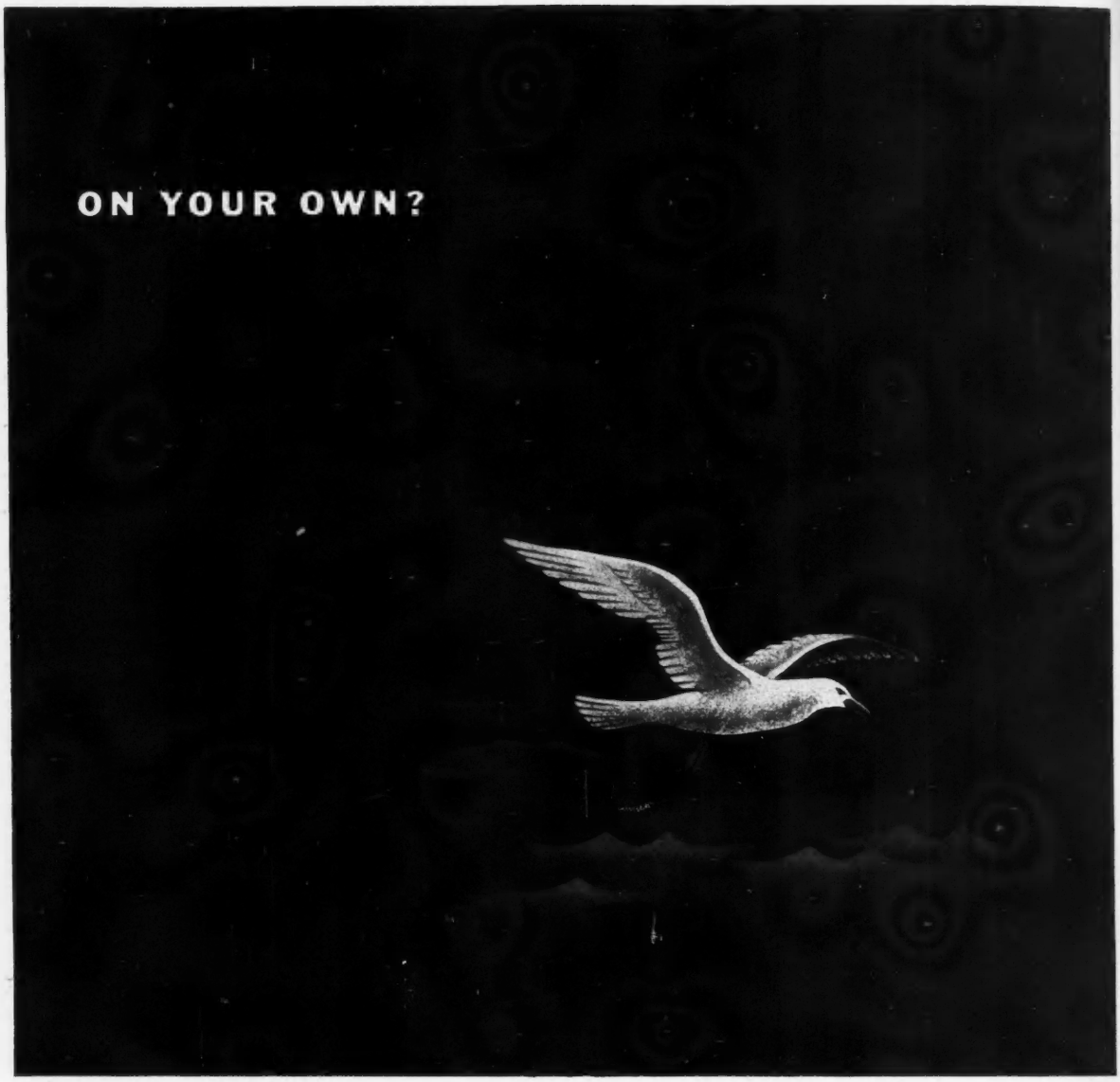

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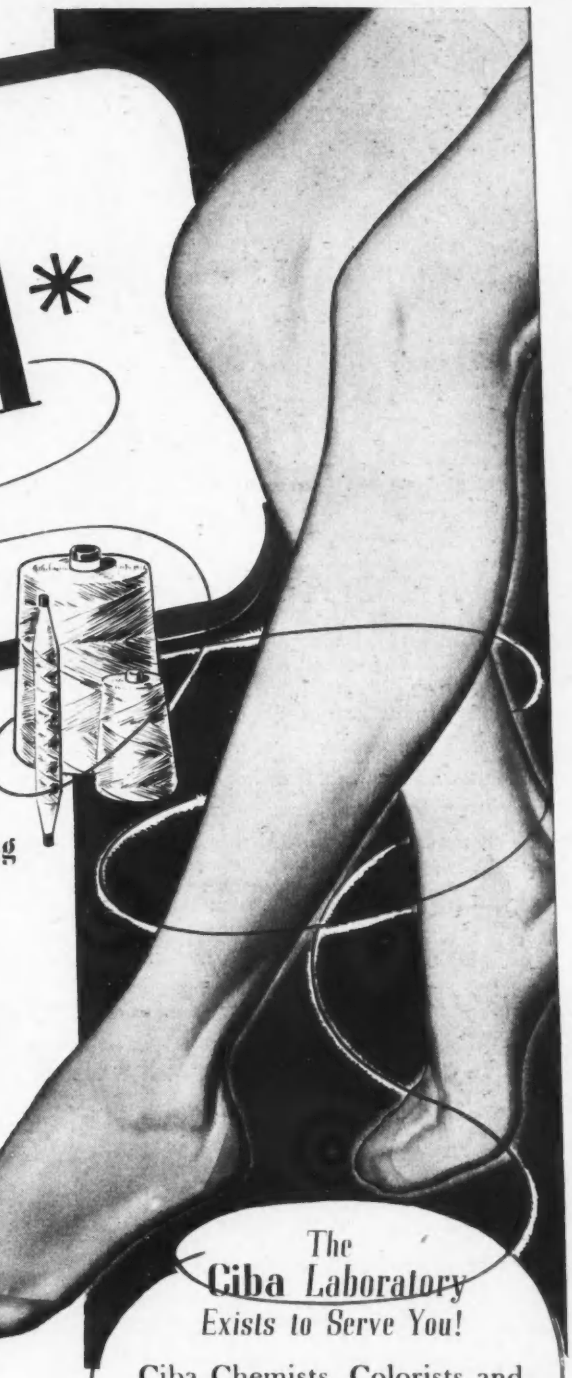

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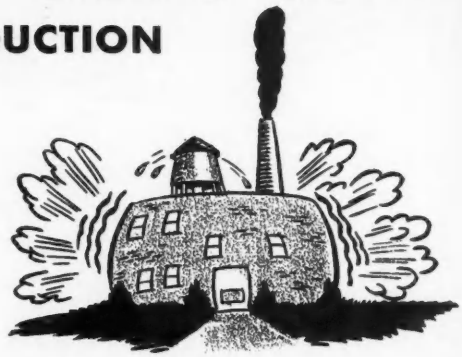

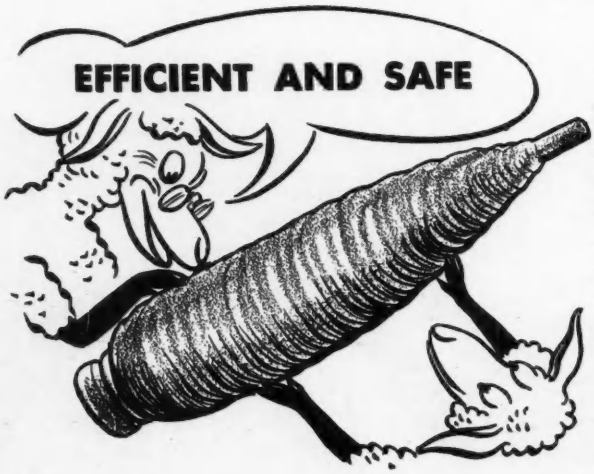

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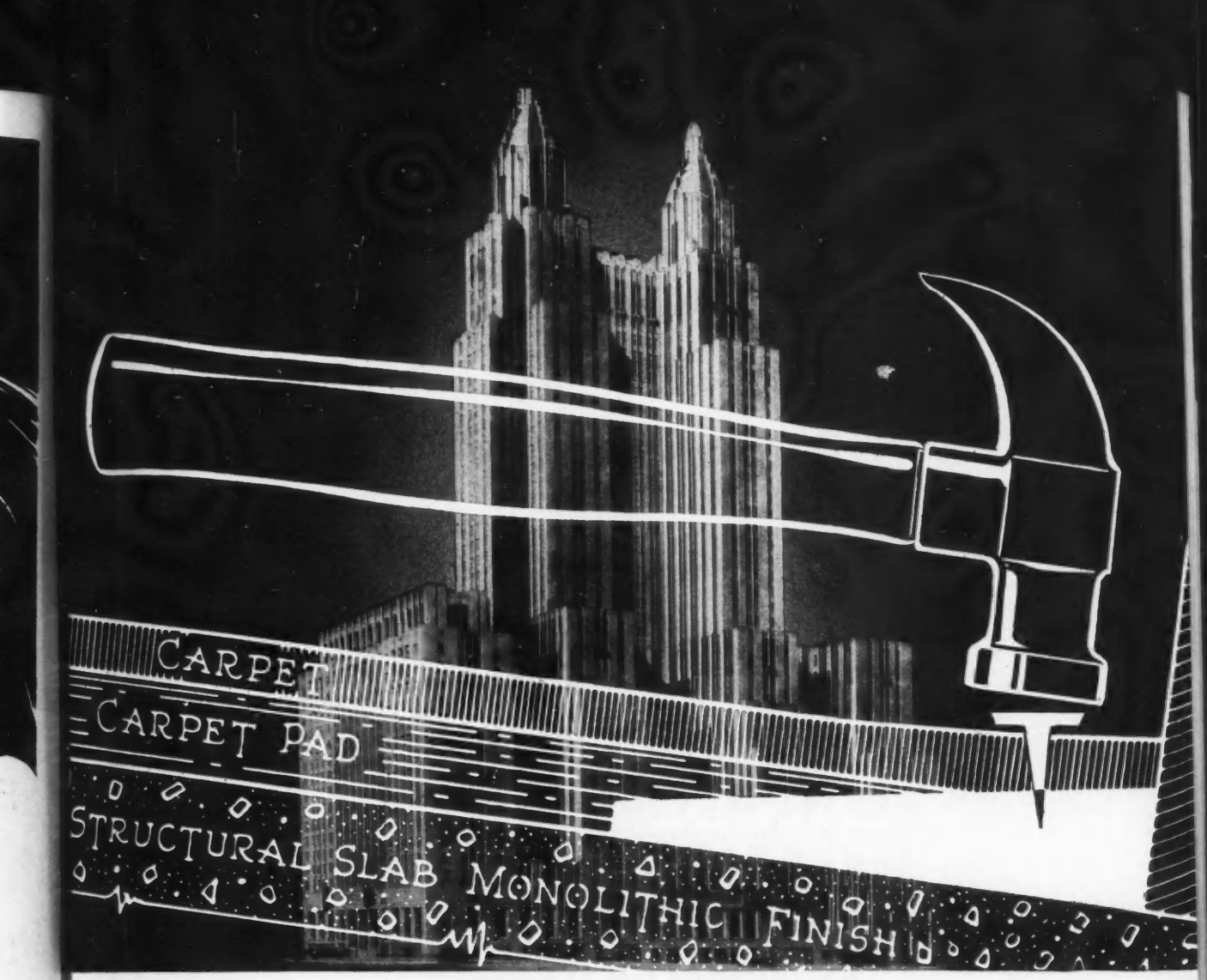

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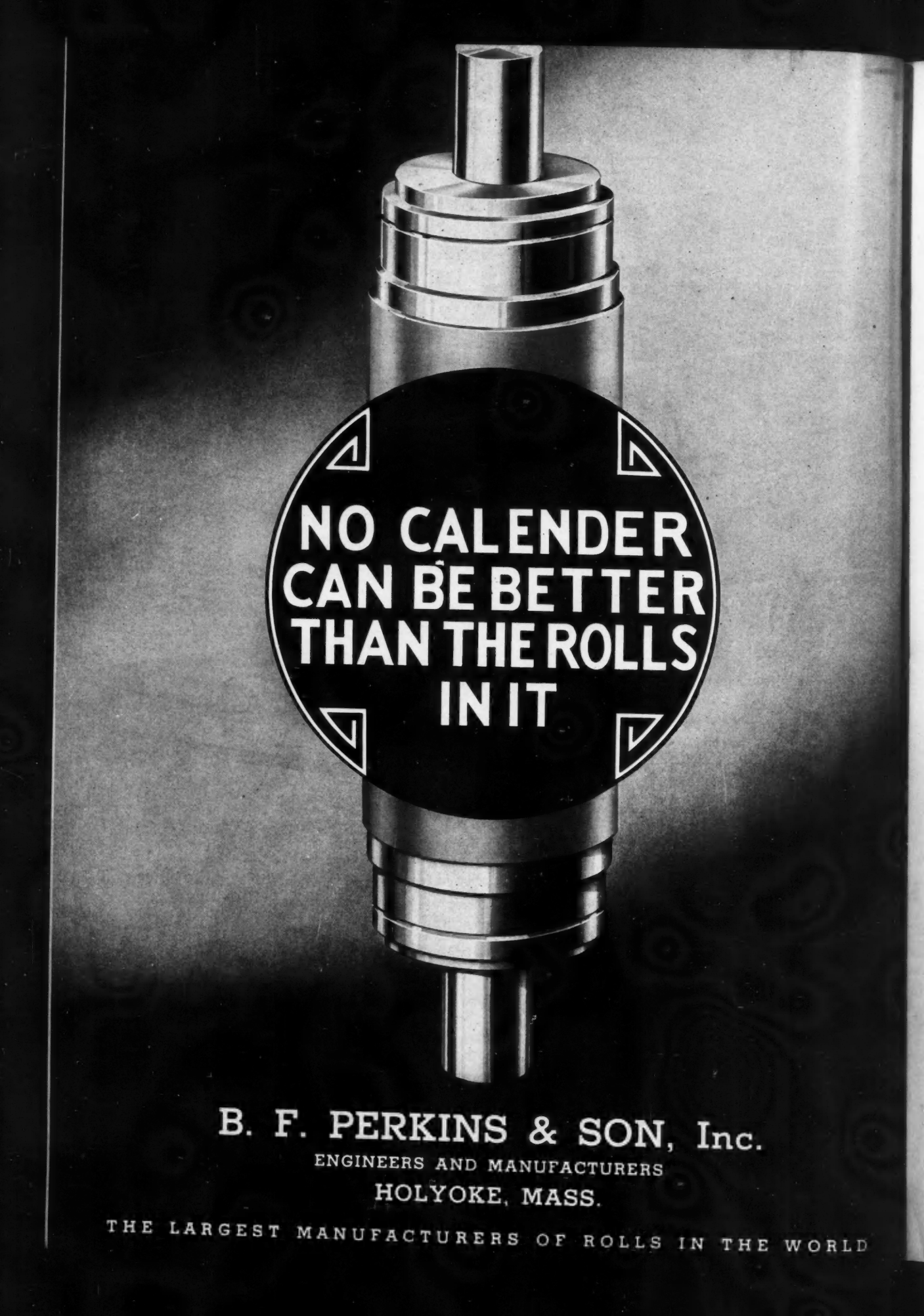

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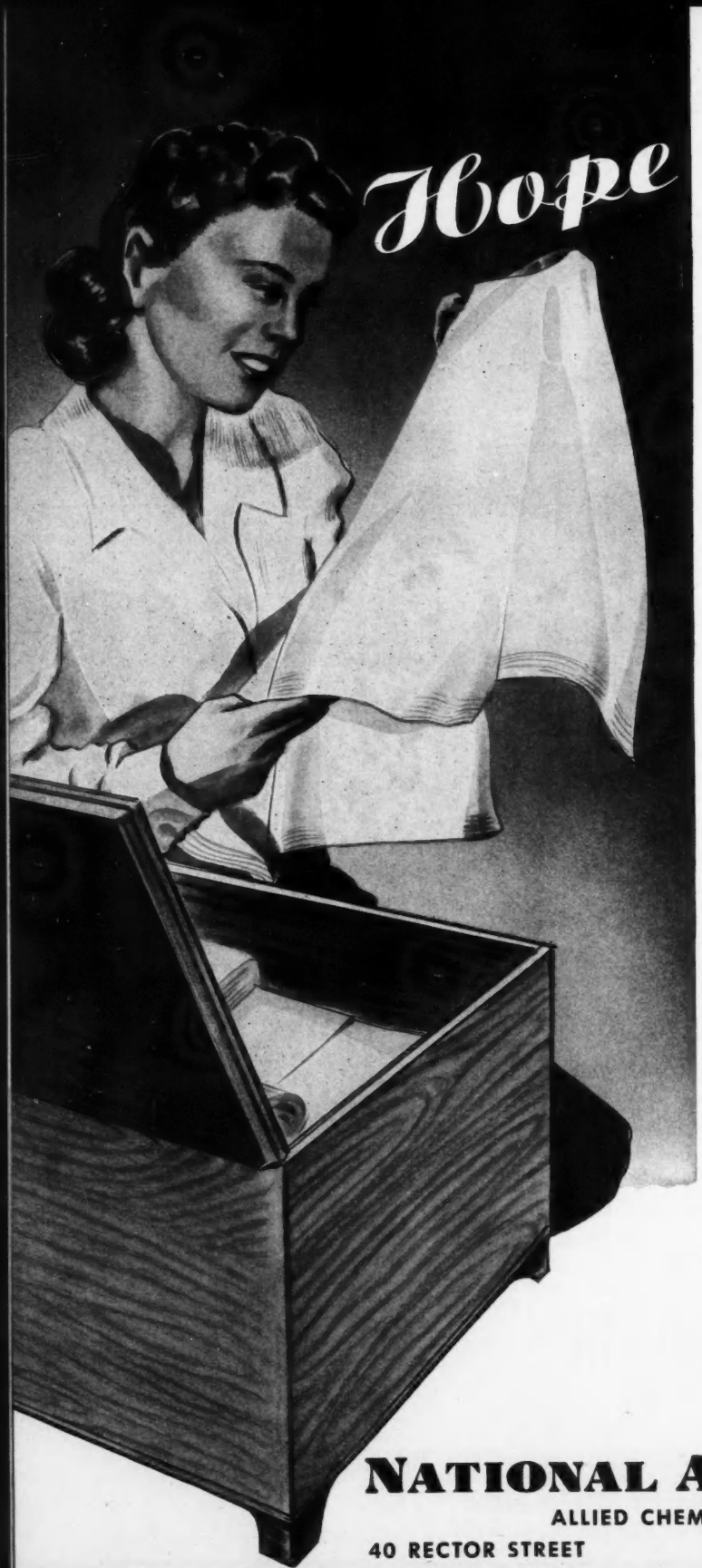

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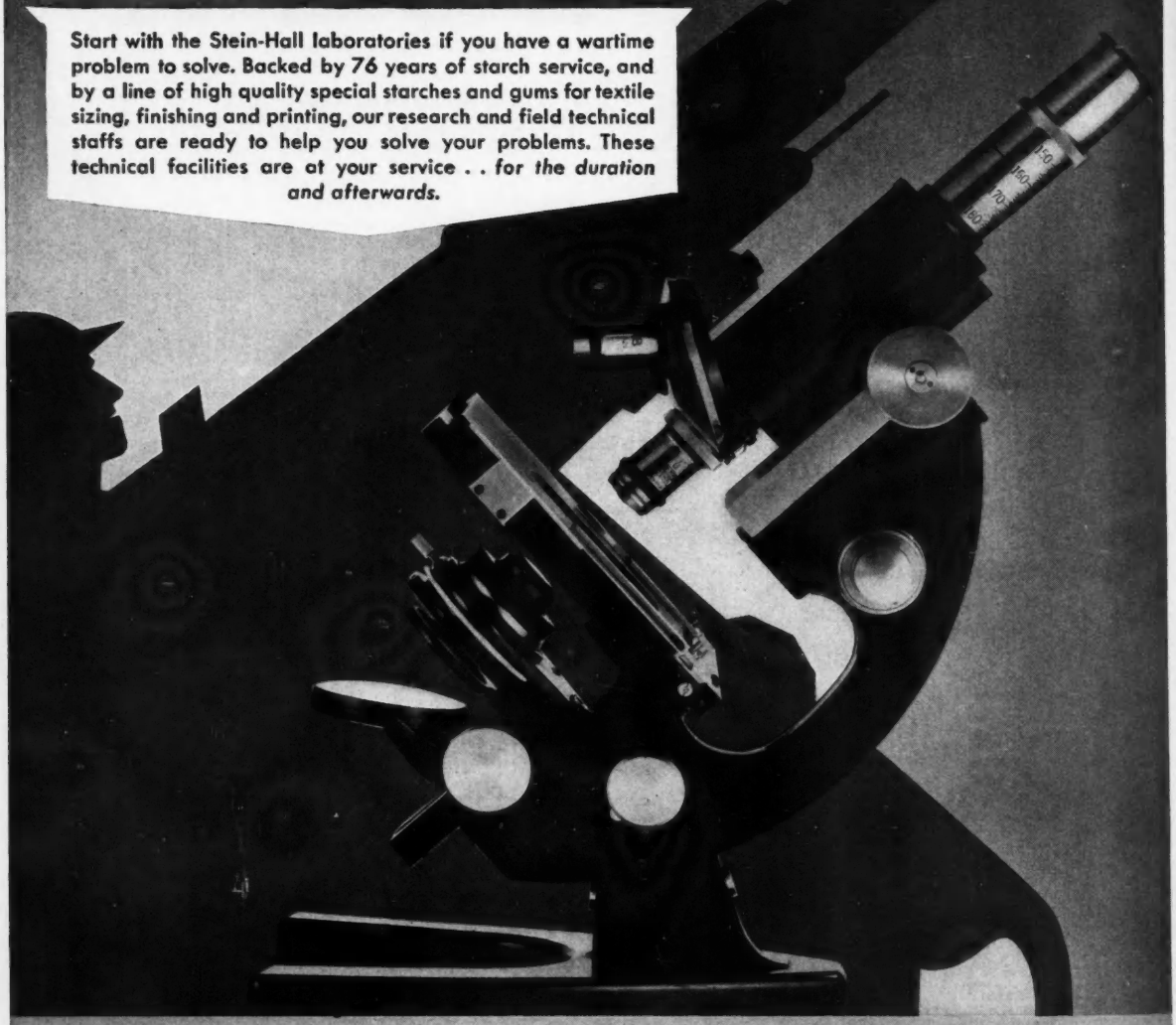

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JUNE 8, 1942

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CALENDAR
of Coming Events

Outing, Philadelphia Section, Manufacturer's Country Club, June 12, 1942.

Outing, Rhode Island Section, Pawtucket Golf Club, Pawtucket, R. I., June 12, 1942. Golf and other sports during day; old fashioned New England Clam Bake served under a tent at 7 p.m.

Outing, Mid-West Section, Lake Lawn Hotel, Lake Delavan, Wis., June 13, 1942.

Outing, New York Section, North Jersey Country Club, Paterson, N. J., June 19, 1942.

Meeting, Piedmont Section, Hotel Charlotte, Charlotte, N. C., June 20, 1942.

Council and Research Committee Meetings, New York, N. Y., June 27, 1942.

Annual Meeting and Convention, Atlantic City, N. J., October 8, 9, 10 and 11, 1942.

Microscopical Observations of UNION DYEING*

H. E. MILLSON and G. L. ROYER

Calco Chemical Division, American Cyanamid Company

EDITOR'S NOTE: At the presentation of this paper before the Northern New England Section, approximately 100 Kodachrome slides were projected. Two projectors were used so that slides could be simultaneously projected side by side for comparison. Since these were in color, only a few could be reproduced in black and white for illustrative purposes.

INTRODUCTION

THE problems connected with the dyeing of any one textile fiber are always numerous enough to keep the average dyer constantly working on their solution. When two or more fibers are blended and dyed, a process commonly called union dyeing, the attainment of uniform results becomes even more difficult. In union dyeing the problems peculiar to each individual fiber are present, and factors such as temperature and boiling time assume great importance. The wide variation in the affinities of different fibers for dyestuffs of various classes and many other factors, some of which will be discussed later in detail, enter into the art of union dyeing. When shoddy and other reworked fibers of unknown origin and dyeing properties are also included in the fabric, the problems of the colorist are further increased. Union fabrics are coming into considerable use because of the present war conditions and as a consequence more attention is now being focused on the mixed fiber dyeing processes. Designers have also added to the difficulties of the dyer by introducing new fibers into fabrics without regard to the possibility of producing an acceptable shade or color effect on the fibers used. In union dyeing the fastness properties of a finished fabric are affected by the types of fibers used in the construction. It is evident, therefore, that the difficulties of dyeing union fabrics generally become greater with an increase in the number of different fibers used in the union. In this paper an attempt has been made to show some facts from our studies which may give a better understanding of some of the more important factors which play a part during the various dyeing processes. The coloring of unions easily ranks as one of the most difficult of dyeing processes, and requires considerable skill to produce satisfactory results.

It must be emphasized that the observations and experiments discussed in this paper were made without considering whether or not equilibrium conditions had been reached. Attempts have been made to carry out the experiments as near practical dyehouse conditions as possible. These experiments have shown that the rates at which dyes exhaust from the dyebath and diffuse into textile fibers are important in commercial dyeings since, in general, time is not always allowed for equilibrium conditions. Even if a dyeing were continued to equilibrium exhaustion conditions. it would not necessarily show uniform distribution of the dye throughout each individual textile fiber. due, in part, to variations in affinity found in both synthetic and natural fibers. Some of this has been discussed in previous papers[1, 2] in which the most pertinent results of the investigation were photographed in color. In this present study the micro-techniques and the methods of taking photomicrographs in color were similar to those previously employed.

UNION DYESTUFFS

Considering the choice of dyes as a determining factor. one finds two main methods of union dyeing. In the one, the colorists prefer to use two distnct types of dyes, one for coloring wool and the other for coloring cellulosic fibers. The shades are matched by selecting, for the cellulose fibers, direct dyes which dye cotton or rayon almost to the exclusion of the wool; and, for the wool, neutral dyeing acid or milling colors. Care must be taken when selecting neutral dyeing acid or milling colors because some types dye certain rayons almost as heavily at the boil as they do the wool, and at low temperatures (160° F.) many dye the rayon much more heavily. This affects the shade adversely because the dye fed on only to correct the shade of the wool also dyes the rayon heavily. When dyes are carefully selected, this method allows for better shade control, permitting higher temperatures for longer periods of time. One of the disadvantages of this method is that a formula for a given shade of brown or maroon may contain eight to ten different dyes equally divided between wool and cotton colors.

In the other method, the dyers use direct colors which have a good affinity for both wool and cellulosic fibers. This method requires more care in the control of temperature, in the time of dyeing, and in the addition of mordants because the wool fills up in shade quickly and then robs the cellulosic fibers of their dye and spoils the solidity of the union. This method, however, has a distinct advantage in that shades can often be produced with one to three dyes in place of six or more. When carefully selected, a single dye often builds up on tone while a mixture of many dyes is likely to vary in tone as the shade becomes stronger. It usually follows that the simpler a formula can be kept, the greater control the dyer has over the shade to be matched.

*Presented at meeting, Northern New England Section, May 15, 1942.

VARIATIONS IN AFFINITY OF FIBERS

Because of differences in chemical composition and physical structure, no two textile fibers have exactly the same dyeing characteristics. Obviously, the greatest differences exist when the fibers are not alike in chemical composition, i.e., the protein or animal types contrasted with the cellulosic or vegetable types. Other marked differences, again due to chemical composition, are to be found in cellulose acetate and the synthetic polymers such as nylon and vinyon.

In addition to these modifications causing differences in dyeing properties among the fibers in these large general classifications, there are also distinct variations in the affinity for dye in fibers within the same classification. This occurs also in the same type of fibers where physical treatments such as stretch, mechanical damage, and heating are involved. Factors such as denier, methods of manufacture, degree or luster and pigmentation also add to the variations found in synthetic fibers. The variations in affinity of each of the general classes of fibers will be discussed.

CELLULOSIC FIBERS

The important cellulosic textile fibers are cotton, both natural and mercerized, viscose rayon, and cuprammonium rayon. In general, among cellulosic fibers, the widest deviations in affinity for dye are found in different cottons because cotton is a natural vegetable fiber. Some of the factors which bring about these conditions are species, soil, rainfall, temperature, sunshine, maturity, etc. Since these factors are beyond control, it is one of the problems of the colorist to select dyes and dyeing methods which will give him satisfactory results on such fibers. When certain dyestuffs are used, the contrast in affinity is accentuated. In such cases, the microscope clearly shows that some fibers are very heavily dyed while others are only lightly dyed. These differences in dyeing are caused by variations in the individual fibers themselves, which, in turn, control the penetration. When other types of dyes are chosen, one obtains an equal distribution even with cottons having wide contrasts in affinity. Many of the dyes which show uneven dye distribution have properties which make them very desirable despite their frequent lack of color uniformity from fiber to fiber. In general, however, it can be stated that the variations in fiber affinity which occur in cotton dyeing are not so great as the differences existing in wool.

The treatment of cotton with caustic to product mercerized cotton alters the affinity of the cotton for the dye. While some of the variations in affinity which occur in the natural cotton are carried over into the mercerized cotton, it is generally true that mercerization results in a more uniform fiber dyeing than is obtained with natural cotton. Obviously the mercerizing process causes a difference in affinity between natural cotton and mercerized cotton. Here again certain dyes will emphasize the dissimilarity in these affinities whereas others can be chosen in which the difference is not so marked.

In the conversion of cellulosic materials to rayon, several different chemical processes may be used. In these processes, the cellulose goes through various chemical and physical treatments which greatly affect the dyeing rate of the cellulose in the finished rayon fiber. Rayons made by two different processes often do not act alike and certain dyes will emphasize this fact. For example, Calcomine Orange 5RE, Colour Index 621, shows quite a marked difference in shade and color strength when dyed on Bemberg rayon as contrasted to the dyeing obtained on viscose rayon. When rayon was first manufactured, variations in dye affinity along the same filament were found and the causes were traced to the changes in tension during the manufacture of the fiber. Present day rayon manufacture has eliminated this difficulty to a great extent by more constant tension during manufacture. Because of the many properties desired in a finished dyeing, it is not always possible to use dyestuffs which have a tendency to eliminate these differences in fiber affinities and, for this reason, it is often necessary for the manufacturer to be satisfied with the best results obtainable under the circumstances.

Variations of fiber affinity are important in rayon-wool unions where rayon may predominate, constituting 70 per cent or even 90 per cent of the mixture. To obtain a satisfactory union dyeing, it is necessary to first produce a solid shade on the rayon itself. Microscopical study of the fiber levelness of rayon has shown that in general this is not a very serious problem since variations from fiber to fiber in the same rayon material are usually not very great. However, rayon has a high rate of exhaustion for certain dyes, as will be mentioned later in the discussion of temperature effects on rayon dyeing.

The difficulties encountered in dyeing uniform shades on rayon and cotton mixes have been recognized for a long time. The rayon generally dyes heavier than the cotton and causes the shade to appear two-toned. A compound such as sodium stannate has been used to decrease the affinity of the rayon for dye because it is absorbed to a greater degree by the rayon than it is by the cotton. This method tends to equalize the amount of color each fiber will absorb, and results in a more uniform shade. When dye is applied to cotton-rayon fabrics by padding, the inherent differences in rate and affinity of these fibers for dye are minimized because of the amount of dye deposited on each fiber is equalized. The relatively short time of immersion in the dyebath, i.e., a fraction of a second, does not allow sufficient time for the adsorbed dye to be redistributed from the cotton to the rayon fibers. This mechanical deposition of the dye limits the amount of dye available to each type of fiber and, therefore, the exhausting rates and affinities which play such an important part in other methods of dyeing are rendered inoperative when

dye is applied by padding. However, there is still a need for a better compound or improved dyeing technique which will produce uniform shades on rayon-cotton materials.

CELLULOSE ACETATE AND OTHER MISCELLANEOUS TYPES OF FIBERS

Variations in individual fiber affinity for dyes in the case of cellulose acetate are quite similar to those which exist in rayon. Since this is an artificial fiber, the variations are not so marked as in the natural fibers, and those which do exist are probably due to differences in physical conditions caused during manufacture or handling. Inconsistencies from batch to batch may be caused by chemical variations, but in general, the manufacturing processes are very well controlled. Some of the newer fibers which have appeared on the market recently often show some variations in dye affinity from fiber to fiber. This is usually caused by the fact that the processes have not been controlled well enough to insure uniformity. It cannot be overemphasized that one of the best methods for showing variations in textile fibers is to select a dyestuff which will emphasize them. Dyestuffs can be found which are very sensitive to slight variations and these dyes could be used for the control and study of the uniformity of synthetic fibers.

PROTEIN FIBERS

The most important of the protein fibers is wool. The heterogeneous nature of this textile fiber has already been demonstrated[1, 2, 7]. In overcoming the dissimilarity of the wool fibers, it is necessary either to change the fibers themselves by pretreatment to equalize their affinity or choose dyestuffs which do not accentuate or show up the variations.

Wool is especially susceptible to treatments of all kinds, and its affinity for dye is often affected in relation to the severity of the treatments to which it has been subjected previous to dyeing. Difficulties encountered in transferring laboratory formulae to full-sized lots have often been traced to the fact that additional treatments such as crabbing, stripping, etc., have been given the practical pieces but not the laboratory stock. The formula developed in the laboratory on wool without pretreatment will therefore call for more dye and a longer boiling time than is necessary for the practical lot. It has also been shown that, under certain conditions, the longer wool is boiled or held in the dyebath at high temperatures, the greater the affinity of the wool for dyes. Of interest in union dyeing is the fact that wool which has not been pretreated in any way has the least affinity for cotton dyes at cold to warm temperatures. Experiments have shown that when wool has once been dyed, its affinity for dyes of all kinds is often increased to such an extent that cotton dyes which normally would not color wool will stain rather heavily, even at low temperatures. When processing stock of this kind, additions of direct dyes which usually will not dye wool heavily will dye on rapidly and increase the depth of shade under these conditions of increased affinity. This abnormal affinity makes more difficult the correction of the shade during dyeing because direct dyes which are known to have poor affinity for animal fibers will suddenly enrich the shade of the wool at the expense of the rayon or cotton. In dyeing wool-rayon or wool-cotton mixes, the wool should be kept on the light side if a good solid shade is desired.

Stripping has a decided influence on the dyeing properties of wool. Shoddy and reworked wools are often blended with virgin wool and rayon or cotton to produce a union fabric. It is generally necessary to strip the shoddy or clips previous to redyeing in order to obtain a suitable bottom for the required shade. One of two methods of stripping is generally employed and both will be discussed.

The pretreatment may consist of a boiling ammonia bath which is usually given to remove as much color as possible in order to insure a lighter bottom. The stock is then boiled for 30 minutes with 3 per cent to 5 per cent of a soluble zinc formaldehyde sulfoxylate type such as Hydrosulfite FS and 2 per cent to 3 per cent of acetic acid 56 per cent. In the other method the stock is boiled for 30 minutes with 3 per cent to 5 per cent of insoluble basic zinc formaldehyde sulfoxylate type and 2 per cent to 3 per cent of acetic acid 56 per cent. After this treatment, the stock may be neutralized with 2 per cent to 3 per cent of ammonia for 20 minutes at 150° F. to 160° F. in order to decrease the affinity for dye.

After most stripping processes, the wool has more affinity for direct dyes as well as for wool dyes. Stripping, however, does not appear to affect cotton or rayon to any great extent. When dyeing unions by the union chromate process on stripped wool, care must be exercised in controlling the exhaustion and also the temperature. High temperature and the addition of common salt will result in the wools robbing the rayon and cotton of most of their dye.

To show the effect of pretreatment on the rate at which wool dyes, skeins of wool treated by five different procedures were dyed separately under accurately controlled conditions in a dyebath buffered at pH 6 at the boil for 45 minutes. Two per cent Calcocid Fast Blue BL, Colour Index 833, was selected because it is sensitive to any slight variation in the condition of the wool. Dyeings were carried out in a buffered solution so as to eliminate any influence on the dyeing rate which could be caused by residual acid or alkali remaining in the skein from the pretreatment procedure. Figure 1 shows the exhaustion time curves for the different methods of pretreatment. Considering the experimental error in obtaining these curves, it was found that the six dyeings could be represented by three curves.

The slowest rate of dyeing, represented as Curve 1, is for wool which had not received any pretreatment and wool which had been scoured with soap and soda ash. Curve 2,

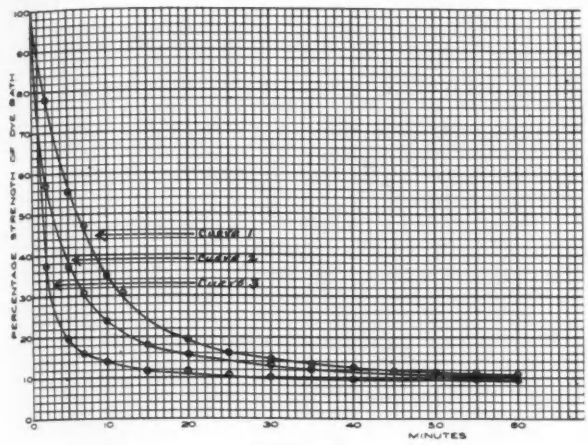


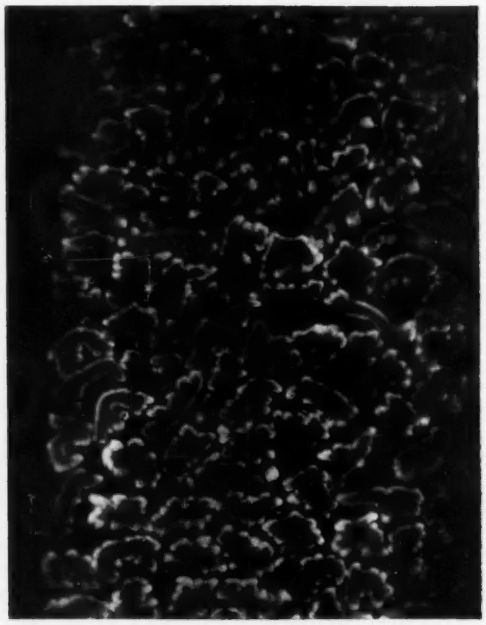
Figure 1

which represents a slightly faster rate of exhaustion from the dyebath, is that obtained with wool which had been given a pretreatment of ½ hour at the boil in water only, wool which had been boiled for 30 minutes in 4 per cent ammonia based on the weight of the goods, and wool which had been given a pretreatment with Calco basic zinc formaldehyde sulfoxylate. Curve 3, which shows the fastest dyeing exhaustion from the bath, is that obtained from wool which had been pretreated with Calco soluble zinc formaldehyde sulfoxylate. These results indicate that the more damage the wool has suffered by the pretreatment, the faster the rate of dye exhaustion from the bath. It is to be noted that at the end of the dyeing period, the amount of dye exhaused on all of the different pretreated wools is about the same, indicating that at an equilibrium exhaustion the amount of dye taken up is not greatly affected by the pretreatment. However, if one examines the skeins from these dyebaths, the results again confirm those which have been published previously[2] in which it was shown that the measurement of the amount of dye exhausted from a dyebath does not necessarily represent the color value obtained on the finished goods. The fiber levelness or distribution of the dye from fiber to fiber will influence the color value and shade obtained on the finished goods. Visual examination of the color strength obtained on the dyeings showed that the wools which had been pretreated by the sulfoxylate method were the strongest, the scoured sample was next in color value, the sample boiled in distilled water next, that boiled for 30 minutes in 4 per cent ammonia was next, and the dyeing which had received no pretreatment showed the weakest color value. These experiments show clearly that the wide variation in color strength and rate of dyeing which can be obtained is due only to the pretreatment which has been given to the wool. This is, therefore, one factor which explains the differences obtained in the action of a given wool dyestuff when applied to virgin wool and when applied to shoddy, reworked, or redyed wool.

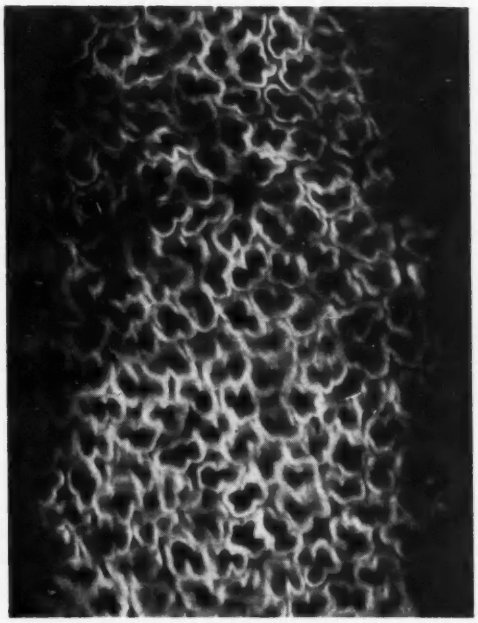
PENETRATION OF DYES

Studies on the mechanism of the dyeing of different textile fibers seem to indicate that three steps take place: first, the removal of the dye from the bath onto the fiber; second, the penetration or diffusion of the dye into or through the fiber; and third, the fixation of the dye within the fiber which may be either a chemical or a physical phenomenon. (This will be discussed in greater detail in a forthcoming paper from our Research Laboratories.) Conditions of the dyebath from which the dye is removed govern to a considerble extent the degree and speed of diffusion or penetration into the various fibers. Excess of acid in the case of wool dyeing may precipitate or deposit the color on the outside of the fiber in such form as to prevent any further diffusion into the fiber. Excess of common salt may cause a similar phenomenon with direct dyes on cellulose fibers. The process of fixation will also control the penetration or diffusion; and so it is obvious that not any one of the steps operates independently in any dyeing procedure.

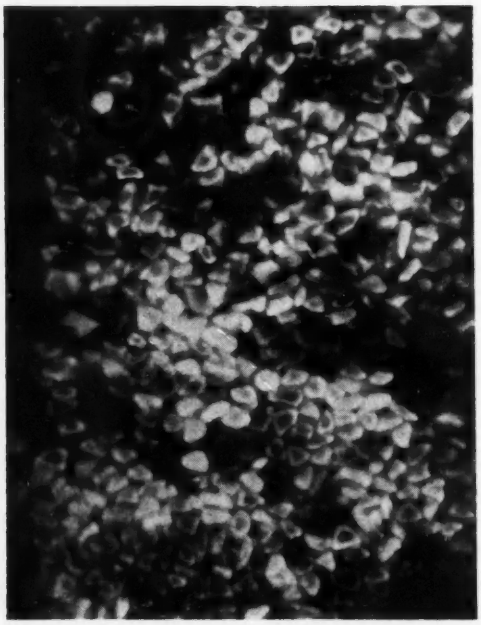
The authors have again[1,2] resorted to the use of fluorescent dyes for diffusion studies because these dyes glow in ultra-violet light and reveal their position within each textile fiber. In this way the speed of penetration of dyes by any method of application can be determined. Slight variations in the surface structure of synthetic and natural fibers can also be detected. The penetration of dyes into textile fibers during dyeing has been studied by microscopical examination of cross-sections made from samples removed at different stages of the dyeing operation. When fibers such as cotton, wool, Aralac, nylon, Lanital, viscose, silk, Vinyon, and acetate have been dyed with fluorescent dyes, the location and extent of penetration of very small quantities of a dye can be detected by examination of the cross-sections in an ultra-violet microscope. Only those portions of the fibers where the dye has penetrated show marked fluorescence; other parts and fibers that have not been dyed at all do not fluoresce. Photomicrographs (see Figure 2) taken with ultra-violet light of cross-sections of samples removed during the early stages of the dyeing operation show that the outer portion of the fiber is fluorescent and therefore dyed, whereas the inner, undyed portion of the fiber does not fluoresce and appears only as a dark area. Every type of fiber studied develops definite ring formation during the early stages of exhaustion of the dye from the dyebath. This development of rings demonstrates that all dyes are absorbed onto the outside of the fibers first. Furthermore, the extent of diffusion and length of time required for complete coloring of individual fibers are dependent upon the type of dye, condition of the dyebath, dyeing temperature, swelling of the fiber and affinity of the fiber for dye. Under adverse conditions, all the dye can be exhausted from the dyebath to the fibers, but very little, if any, diffusion of the dye into the fibers will be obtained. Since all fibers



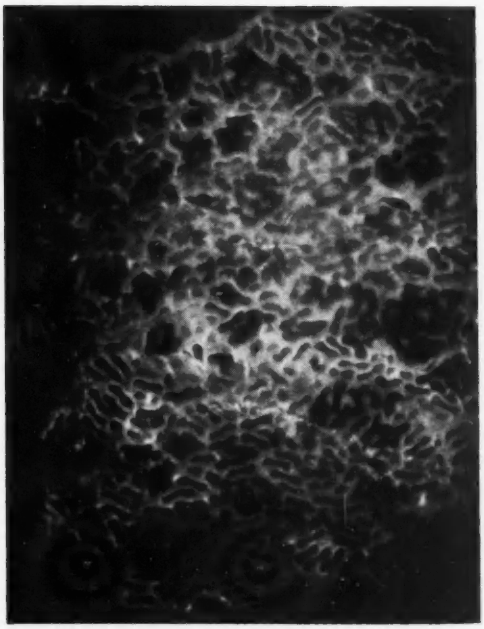
Viscose Rayon



Acetate Rayon



Silk



Vinyon

FIGURE 2

absorb dye on their outside surfaces, it is extremely important for textile fibers to be clean and free of extraneous materials in order to allow for the proper penetration of the dye. When they are not removed, oils, greases, waxes, and materials of this kind usually appear as resist spots because they do not allow the dye solution to come in contact with the fibers and therefore no deposition of the dye can take place.

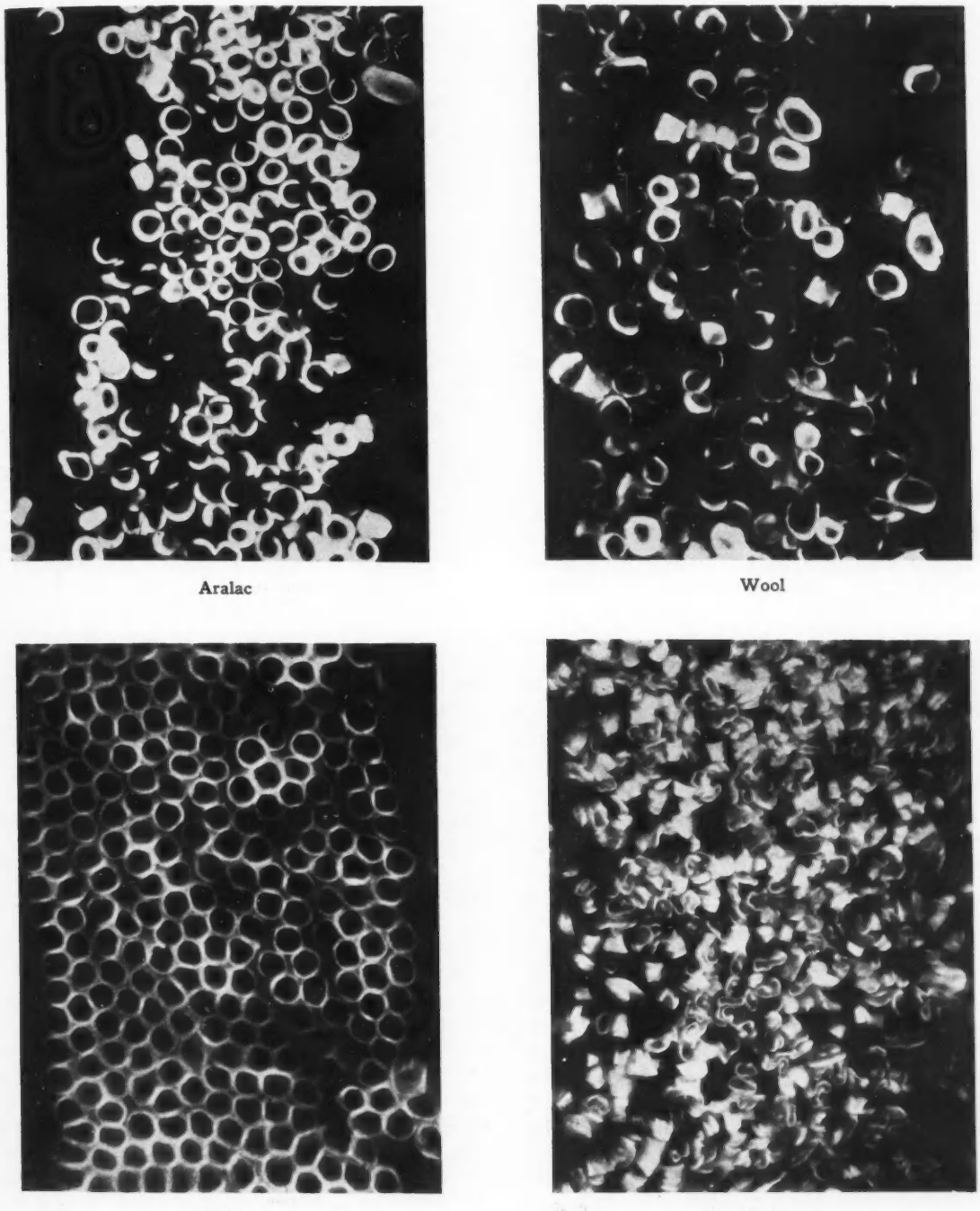


FIGURE 2

It had previously been shown by the authors[1, 2] and independently observed by Boulton and Morton, in the case of viscose[6], that dye penetration into the individual fibers takes place from the outside surface and that after the dye has left the bath, the dye still distributes itself within the individual fibers. Exhaustion of the dyebath is an important factor, but even when this has come to an equilibrium value (per cent exhaust remains practically

constant) it does not mean that the diffusion of the dye within the fibers is uniform or has come to equilibrium. Redistribution or leveling of the dye from fiber to fiber and within the individual fibers is dependent also upon the temperature, length of boiling or running time, and condition of the dyebath. Studies carried out in our laboratories on washing have shown that diffusion within the fiber is a factor controlling the amount of dye removed at the surface of the fiber. In boiling, during the dyeing of union materials containing Aralac, one can see that the color is removed from the outside of a completely dyed Aralac fiber, leaving a dyed center surrounded by a colorless ring. This is similar to what has been found on the cross-sectional examination of many dyeings after being subjected to a wash test. Thus it can be seen that the rate of diffusion is a controlling factor, the speed of which governs to some extent the phenomena of dyeing, leveling, wash fastness and crocking.

IMPORTANCE OF TEMPERATURE

The proper regulation of temperature and the length of boiling time govern to a considerable extent the balance of tone necessary for the production of solid shades on union materials. For example, rayon has a much greater affinity for dye than cotton and, therefore, such mixtures require careful attention in regard to temperature in order to attain a satisfactory union dyeing.

Wool has excellent affinity for most dyes and careful regulation of temperature and boiling time is necessary in order to prevent the wool from robbing fibers such as rayon, cotton, Aralac, etc., of their dye. In wool-rayon or wool-Aralac fiber mixtures, both the rayon and Aralac fibers absorb dye quickly at low temperatures and are generally much heavier in shade than wool when the boil is reached. However, as the boiling time is extended the conditions are reversed, the affinity of the wool for dye increases until the wool becomes quite heavy at the expense of the shade on the other fibers. In dyeing mixtures of cotton and rayon or rayon and wool, a careful balance between the boiling time and the amount of exhaustants used must be maintained in order to obtain good solid shades. Experiments have shown that all fibers are dyed more uniformly with improved penetration at higher temperatures than when dyed cold.

It is well known that different direct dyes exhaust best at various temperatures, some at 20° C., and others do not develop their full shade until 100° C. has been reached. Mixtures of dyes with different exhausting temperatures and rates give unexpected shades at different temperatures. In order to obtain reproducible results, dyes must be carefully selected. In various combinations those dyes which boil off during prolonged boiling remain in the bath until the temperature is reduced to their best dyeing range, and then they go on again.

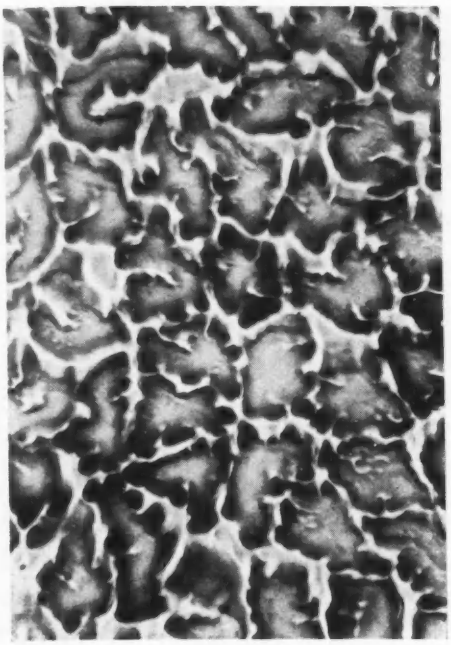
As a general rule, direct dyes show better color strength and clarity of shade when dyed above 130° F. Experiments have shown that direct colors which have been applied to rayon at low temperatures are capable of further strength and shade developments if boiled in a fresh bath with the addition of only common or Glauber's salt. Calcodur Blue SL, Pr. 71, and Calcomine Black BHD, Colour Index 401, are two examples of dyes in this class. Exhaustion of the dye by rayon without uniform diffusion of the dye through the individual fibers results in weak dyeings with an accompanying dullness of shade. In rayon dyeing, as has been shown to be the case with wool, maximum exhaustion in the dyebath at low temperatures does not always yield maximum development of the potential color value. Shade development is dependent, at least to some extent, upon proper diffusion or distribution of the dye into the rayon fibers. (See discussion on "Low Temperature Dyeing.")

TEMPERATURE EFFECTS ON RAYON DYEING

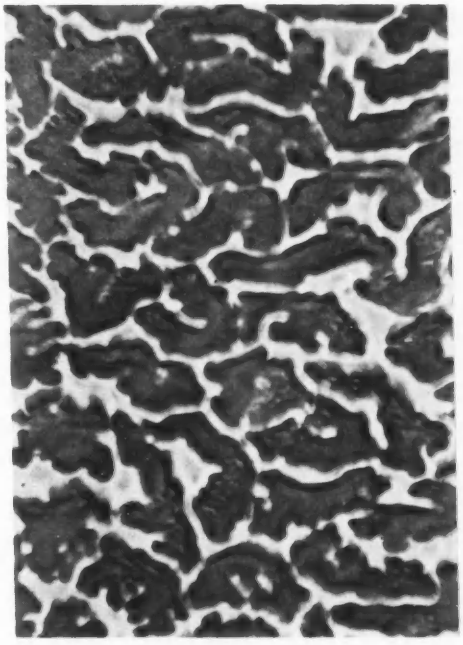
Since many rayon-wool unions are predominantly rayon, often in the order of 80 per cent rayon to 20 per cent wool or Aralac, it is essential to have the rayon level and well penetrated. Proof of some of the facts discussed above is shown in experiments in which rayon was dyed with various direct dye mixtures. The dyes used were selected because their dyeing characteristics varied greatly with temperature. Experiments were conducted by starting with ten five-gram skeins in the same dyebath. One skein was removed and rinsed at the desired temperature during the dyeing process. These were then cross-sectioned and examined under the microscope and photographed in Kodachrome.

Cross-sections were made of skeins removed, as explained above, during the dyeing of a shade made with a mixture of 2 per cent Calcomine Chinoline Yellow P, Colour Index 802, 1½ per cent Calcodur Grey L, Pr. 24, and 2 per cent Calcodur Brown 4RL, plus 40 per cent common salt. The cross-section of the sample removed at 100° F. shows the Grey L just starting to penetrate into the rayon fiber. The sample removed at 180° F. shows the Grey completely penetrated into the fiber and the Yellow P has started to penetrate the outer portion. At 212° F. the Yellow P and the Brown 4RL have penetrated still further and after 20 to 40 minutes at the boil the Brown 4RL has not completely diffused into the entire fiber. On cooling down to 120° F. at the end of the dyeing, no further penetration is obtained, but there is an apparent increase in color strength. The Brown 4RL is still concentrated on the outside of the fibers while the centers appear grey.

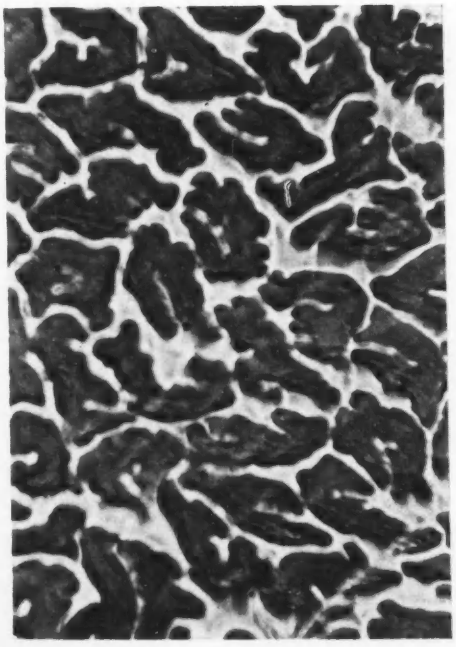
Each of the above colors was dyed separately on rayon under similar conditions. The Yellow P shows good penetration in the early stages and is level fiber dyed at the end. The Grey L shows ring formation at 100° F. but has diffused into the fibers at 140° F. and is level thereafter. (See Figure 3.) The Brown 4RL is undyed at 100° F. The sample removed at 212° F. shows ring formation and this condition continues throughout the entire dyeing



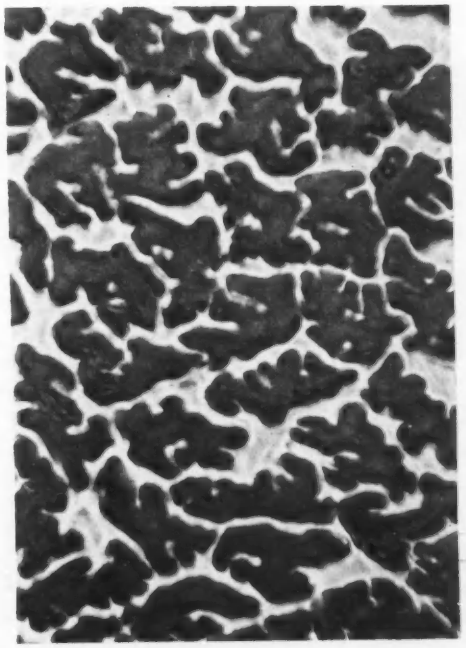
100° F.



212° F.



212° F., 40 Min.

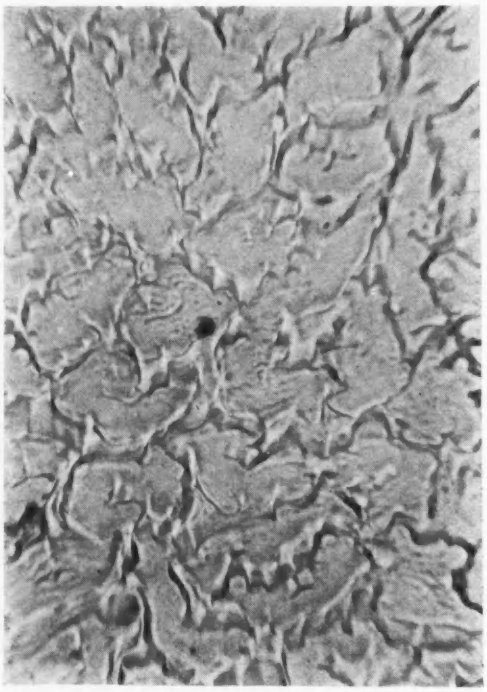


Cool to 120° F.

FIGURE 3—GREY L

operation. (See Figure 4.) In this example the dyes appear to act the same in combination as they do when dyed independently. However, cases are known where one dye will influence the penetration of another dye.

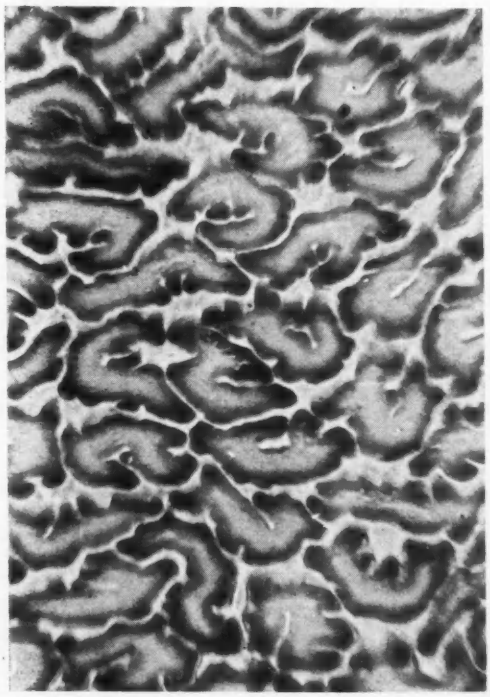
The examination of the rayon dyeing made with 3 per cent Calcomine Brilliant Flavine S, Colour Index 816, 1½ per cent Calcomine Dark Blue B, Pr. 20, and 1½ per cent Calcodur Red 8BL, Colour Index 278, plus 20 per cent anhydrous Glauber's salt, shows that at a temperature of 100° F. the Calcodur Red 8BL has started to penetrate into the fibers. At 180° F. the Red 8BL is completely penetrated and the penetration of the Blue B



100° F.

212° F.

212° F., 40 Min.



Cool to 120° F.

FIGURE 4—BROWN 4RL

is quite noticeable. At 212° F. the Blue B has changed somewhat to a grey due to the start of the penetration of the Brilliant Flavine S. Twenty minutes at the boil has produced penetration of all the dyes into the fibers, giving

a brown shade. Forty minutes at the boil shows further leveling. On cooling down to 120° F., the shade becomes much redder due to the fact that the ideal exhausting temperature of the Red 8BL has been reached and the dye is again exhausted from the dyebath and taken up by the fiber.

Another series, dyed with 1½ per cent Calcomine Brilliant Pink SX Concentrated, Colour Index 225; 1½ per cent Calcomine Blue RW, Colour Index 512, and 2 per cent Calcodur Yellow BL, Colour Index 814, plus 4 per cent common salt, shows that at 100° F. the Pink SX has penetrated throughout the fiber. At 180° F. the Pink SX has completely penetrated the fibers and the Blue RW has started to penetrate, appearing as a ring formation. At 212° F. the Blue RW had diffused much further into the fiber and the shade has become somewhat grey due to a slight penetration and diffusion of the Yellow BL. After twenty minutes at the boil, the shade turns to grey due to a combination of the three colors. Forty minutes at the boil shows a uniform increase in color strength. On cooling to 120° F., the dyeing becomes uneven and distinctly redder due to the uneven absorption and lack of diffusion of the Pink SX by the fibers at the lower temperature.

THE EFFECT OF TEMPERATURE AND TIME IN UNION DYEING

The following series of experiments was made on a number of mixes prepared by carding together equal parts of each fiber, using 1 per cent Calcomine Red FC, Colour Index 419, 20 per cent anhydrous Glauber's salt and 20 per cent common salt. Samples were removed at 100° F.—120° F.—140° F.—180° F.—212° F., boiled 20 minutes, boiled 40 minutes, cooled to 180° F.—160° F.—120° F. Except when boiled, the samples were removed at about five-minute intervals. A cross-section was made of each sample and photographed. This was to show the variations in the affinity of various fibers for dye at different times and temperatures during dyeing. Calcomine Red FC was selected for these tests because it dyes a large number of textile fibers.

NYLON AND RAYON

In the case of rayon and nylon, the cross-section of the dyeing removed at 140° F. shows that the rayon has started to dye with definite ring formation, whereas the nylon has not absorbed any dye. At 212° F. the dye has completely penetrated the rayon fibers although it is not evenly distributed from fiber to fiber, and the nylon has just started to dye showing ring dyeing. After boiling 40 minutes, the rayon is still uneven and the nylon is quite uniform, but the color has not completely penetrated. On cooling down to 120° F., the rayon levels out apparently and the nylon is better penetrated but much lighter in shade.

NYLON AND WOOL

In the union dyeing of nylon and wool, a sample removed at 140° F. shows practically no dye penetration into either the nylon or wool. The sample removed at the boil shows definite ring formation on the nylon and fiber selectivity on the wool (i.e., some fibers are dyed while others are only partially dyed.) Forty minutes at the boil shows that the nylon is nearly uniformly penetrated while the wool is quite unlevel from fiber to fiber. A sample removed after cooling to 120° F. still shows the nylon quite uniform, whereas the wool lacks uniformity.

NYLON AND COTTON

The dyeing of nylon and cotton at 140° F. shows that the cotton is dyed rather well and the nylon shows no dye absorption whatsoever. At the boil the nylon shows ring formation and the cotton is quite uniformly dyed. When boiled 40 minutes, the nylon is uniform but does not show complete penetration into the inner portions of the fiber. The sample taken after cooling to 120° F. shows both the nylon and cotton to be heavier in shade.

NYLON AND SILK

At 140° F. the silk is only slightly dyed; the nylon is undyed. At the boil the silk is completely dyed and the nylon is starting to dye, showing some ring formation. Forty minutes on the boil, the silk is well dyed and the nylon is completely but lightly dyed. After cooling to 120° F., both silk and nylon appear to be heavier in shade.

NYLON AND ARALAC

At 100° F. neither fiber shows any absorption of dye. At 180° F. Aralac is starting to form rings whereas the nylon is not dyed to any extent. At 212° F. all Aralac fibers are dyed, whereas the nylon is uniformly ring dyed. Boiled 20 minutes, all Aralac and nylon fibers are dyed and the nylon shows rings. Boiled 40 minutes, Aralac is well penetrated and completely dyed while the nylon shows some completely dyed fibers and others ring dyed. When cooled to 120° F. the shade is somewhat more level and slightly heavier. The nylon in this series appeared to penetrate and level better than it did when dyed with rayon or cotton. This may be due to the absorption by the nylon of a small amount of acid from the Aralac.

ARALAC AND COTTON

At 100° F. the cotton has started to dye, whereas the Aralac shows very little, if any, penetration. At 180° F. the Aralac has started to dye and shows distinct ring formation. At 212° F., the Aralac has become very much darker than the cotton. The cotton shows quite uniform distribution of the dye through the fibers. After 20 minutes at the boil, the cotton is considerably lighter and the Aralac much darker. After 40 minutes at the boil, the Aralac is much darker than the cotton. Cooling down to 120° F. shows the Aralac uneven and the cotton much lighter in depth of shade than the Aralac.

ARALAC AND WOOL

At 100° F., only one or two Aralac fibers appear to be dyed. At 180° F., the Aarlac is definitely ring dyed. At the boil, the Aralac shows complete penetration of dye into the fibers and the wool is starting to dye. Twenty

minutes' boil shows the wool more completely dyed and the Aralac starting to lose dye and forming a white ring on the outside. Forty minutes at the boil shows the wool lightly dyed and the Aralac has a distinct light ring around the outside of the fiber. On cooling down to 120° F., some of the dye has returned to the outside portion of the Aralac and the wool is lightly dyed.

ARALAC AND RAYON

At 100° F., the rayon shows good penetration of dye into the fibers with no dye penetration of the Aralac. At 180° F., the rayon is still completely dyed and the Aralac shows ring dyeing. At 212° F., some of the Aralac fibers are completely dyed and much heavier than the rayon fibers, but there are a few Aralac fibers lighter in intensity than the rayon. At 20 minutes' boil, the Aralac fibers are very dark in comparison to the rayon, both are well penetrated, but the rayon has lost some of its former color strength. Forty minutes at the boil shows further loss of color from the rayon with the Aralac very evenly dyed. On cooling down to 120° F., the Aralac is still considerably heavier in shade than the rayon; however, the rayon has picked up more color on cooling down.

RAYON AND WOOL

At 100° F., the rayon is dyed red and well penetrated. At 180° F., the rayon is very evenly dyed, whereas the wool has not taken any dye. At 212° F., the rayon is still heavily dyed, and the wool is just starting to dye. At 20 minutes at the boil, the wool is dyed and the rayon is lighter in shade than at 212° F. After 40 minutes at the boil, the rayon and wool are about the same in intensity. On cooling down to 120° F., the two fibers are heavier in color and about the same in intensity.

RAYON AND COTTON

At 100° F., both the rayon and cotton are lightly dyed, the rayon being slightly heavier than the cotton. At 180° F., the rayon is much heavier than the cotton. At 212° F., the rayon is still more heavily dyed than the cotton, but the cotton is increasing in color strength. On boiling 20 minutes, the rayon is still more heavily dyed than the cotton, but the cotton is still gaining in color strength. Forty minutes at the boil shows both the rayon and cotton becoming stronger. On cooling to 120° F., there does not seem to be any marked change, but the rayon is still heavier in shade than the cotton.

COTTON AND WOOL

Sample taken at 100° F. shows that the cotton has started to dye and the wool is undyed. At 180° F., the cotton is quite heavily dyed, whereas the wool is still undyed. At the boil the cotton is lighter in shade and the wool shows some fibers completely dyed while others have rings. Sample taken after boiling 20 minutes shows all of the cotton and many of the wool fibers to be about the same in shade but some of the wool fibers are darker due to fiber selectivity. Boiled 40 minutes, all the wool fibers are heavier than the cotton. Cooled down to 120° F., the wool shows heavily and lightly dyed fibers. All fibers, however, are darker than the cotton. The cotton has become darker than the boiled sample due to the further absorption of dye during the cool-down.

RAYON, COTTON, WOOL, AND ARALAC

This series represents the dyeing of rayon, cotton, wool, and Aralac with 1 per cent Calcomine Red FC, 20 per cent anhydrous Glauber's salt and 20 per cent common salt. In the sample removed at 100° F., the rayon shows ring formation, cotton has absorbed some dye, whereas the wool and Aralac are undyed. At 180° F., the rayon is heavily dyed, cotton is dyed completely but lighter in shade than the rayon. Aralac shows ring formation and the wool is still undyed. At 212° F., the rayon, cotton and Aralac appear to be a fairly close match and the wool shows well penetrated and ringed fibers. When boiled 20 minutes, the Aralac fibers are quite dark. Rayon, cotton, and wool are about the same shade. Boiling for 40 minutes shows the Aralac and wool heavier in shade than the rayon or cotton. Sample removed after cooling to 120° F. shows all the fibers to be heavier in shade. The Aralac and wool, however, are much heavier than the rayon and cotton.

RAYON, ACETATE, AND WOOL

Dyes used were: 1 per cent Calconese Sapphire Blue 2GS and 1 per cent Calcomine Red FC. At 100° F., none of the fibers appeared to be dyed heavily enough to show color in cross-section. At 180° F., the wool and rayon show slight red coloration and the acetate shows a very light blue ring formation. At 212° F., the acetate has a definite blue ring formation; the rayon is dyed darker than the wool. At 20 minutes' boil, the acetate and rayon appear to be completely dyed while the wool is very light red in color. Forty minutes shows the rayon and acetate becoming darker and the wool is starting to dye slowly but more yellow in shade. On cooling to 120° F., no marked differences can be seen.

LOW TEMPERATURE DYEING

Speck dyeing comes under the heading of low temperature dye application and at best is only partly satisfactory. From an economic point of view it is wasteful and results in reduced fastness properties for fabrics so treated. High temperatures are impractical for speck dyeing because the wool is generally stained heavily even with the use of compounds which prevent the absorption of dye by the wool. Speck dyes are usually selected because of their lack of affinity for wool. However, we have previously discussed the many ways by which wool can be given an increased affinity for dyes of all kinds. Speck dyeing is done to color rayon, cotton, and other cellulosic materials after the wool has been dyed. For this reason, elevated temperatures must be avoided in order to restrain the wool from absorbing the cotton dye. In spite of these precautions, a considerable portion of dye adheres loosely to the wool and reduces the fastness to crocking, water, and washing of a fabric so treated. Because of this, speck

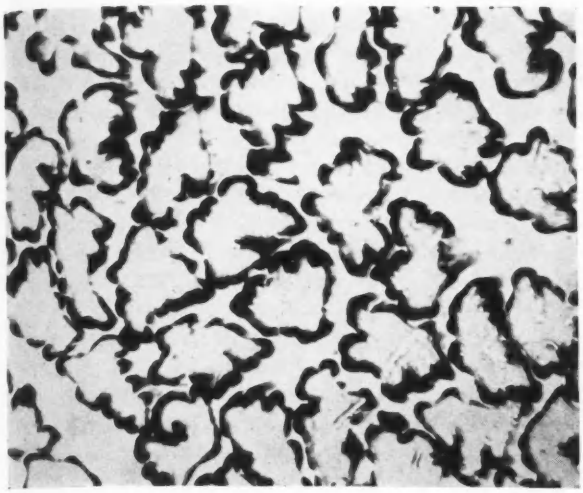


Figure 5

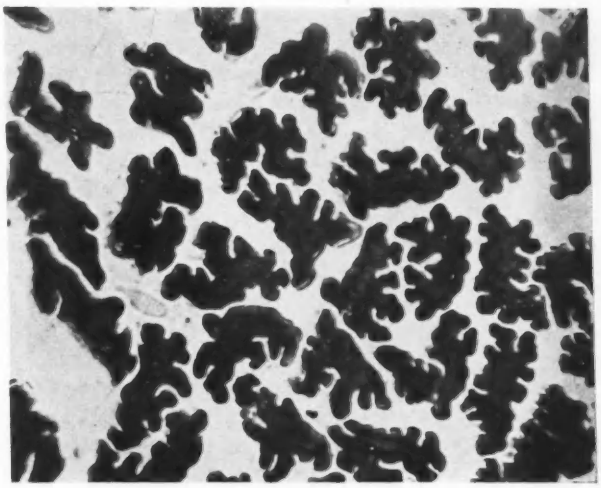


Figure 6

dyeing might be likened to a painting or staining process rather than to an actual dyeing operation. The best rule for speck dyeing might be summarized by stating that the temperature should be raised as high as possible; even an increase to 5° to 10° F. may sometimes improve the fastness and color development. The wool should be reserved as far as possible and dyes should be selected with maximum affinity for rayon and cotton and a minimum for wool at low temperatures.

Cold or speck dyeing experiments were conducted in which rayon skeins were dyed with 6 per cent of Calcomine Black BHD and 40 per cent of common salt. The temperature was held at 80° F. for 45 minutes. The skeins were then rinsed carefully. One was dried while the other was placed in a fresh bath of distilled water and 40 per cent of common salt, brought up to the boil, and boiled for ½ hour, after which time the skein was rinsed and dried. Cross-sections made from these dyeings show that a dyeing made cold (80° F.) has penertated only the outside portions of the fibers giving a ring formation with some fibers showing heavier areas of dye deposition. (Figure 5.) After boiling, examination of the skein shows that the dye is distributed throughout the various fibers and results in a cross-section which is level and well penetrated. (Figure 6.) Examination of the skein dyed at 80° F. and the one that was boiled shows considerable development of color value in the boiled skein and a distinct difference in shade. This indicates also that good color value is not obtained in speck dyeing where the dyeing is carried out at low temperatures. Proper distribution of the dye within the fibers is only obtained when the temperature has been raised and it is possible for dye to penetrate and diffuse into the various fibers. Tests also show that the fastness to crocking and wet-finishing operations are not so good when the dyes are applied cold as when processed at a higher temperature.

UNUSUAL DYE AFFINITY

A combination of dyes such as Calcomine Orange 5RE and Calcomine Black BHD, Colour Index 401, does not dye all cellulosic types of fibers the same shade. For example, in a mixed fabric the unmercerized and mercerized cotton dye yellow, pigmented Bemberg dyes a heavy orange, whereas pigmented viscose rayon dyes blue.

In union dyeing, care must be exercised in the use of certain dyes for wool such as Calcocid Milling Red GP, Colour Index 430, because this type also dyes cellulosic fibers. This causes difficulty as an addition of the Red GP, which might be made to shade over the wool, may also be taken up by other fibers present in the mix. Dyeings were made with Red GP, on skeins of wool, viscose, bright and delustered Bemberg which were processed in the same dyebath. All of the cellulosic fibers as well as the wool were dyed rather heavily.

USE OF SALTS AS EXHAUSTANTS

Care must be exercised in the use of exhausting salts in dyeing unions of wool, rayon, cotton, Aralac, nylon, and silk. The best results are obtained by adding the salt in several portions rather than by adding the total quantity at one time. Addition of these exhausting salts in several portions allows for a less drastic exhaustion of the dyebath and, consequently, there is less danger of precipitation of the dye. It is a well-known fact that dyes are less soluble in salt solutions and it is in this way that they are separated from the mother liquor during manufacture. Dyes can be precipitated out of the dyebath during the dyeing by careless additions of excessive amounts of salt. Under such conditions bronzy effects result due to the crystallization of dyes on the outside of the fiber. Not all dyes have the same solubility or are affected the same by the addition of salt. The degree to which the dyebath exhausts with the addition of a salt depends not only on the percentage of salt which is added

but also, to a large extent, upon the liquor-to-stock ratio. Obviously, longer baths require more salt than very short baths. Three per cent dyeings of Calcodur Brown 4RL and 3 per cent Calcomine Yellow Brown K Ex. were made on cotton and rayon skeins at a liquor ratio of 1-20 using 20 per cent common salt, at 1—1000 using 20 per cent common salt, and at 1—1000 using 1000 per cent of common salt. (All values were based on the weight of cotton and rayon.) The difference between the color strength on the cotton and rayon appeared to be much less in the long bath of 1—1000 with 20 per cent common salt, but the shade was very weak on both. However, when the salt was increased to 1000 per cent in the long bath of 1—1000, the shades obtained on both the cotton and rayon were only slightly weaker than those obtained in the 1-20 bath with 20 per cent common salt. However, both methods produced a much heavier shade on the rayon than on the cotton. The shades of both dyeings made in the long liquor and a high percentage of common salt were much brighter and yellower than the shades produced by dyeing in a liquor ratio of 1-20 and 20 per cent common salt. The danger of over-salting a dyebath is greater in dyeing heavier shades than in light or pastel shades. In the dyeing of wool, the use of common salt causes more rapid exhaustion of dye than when Glauber's salt is used. Neutral dyeing wool colors give better color value when common salt is used, but it is more difficult to control the shade and prevent the wool from dyeing too heavily if large quantities are used in a boiling bath.

Much has been written on the sensitivity of direct dyes to salt. Whittaker[3] states that "the salt sensitivity of some direct cotton dyes is so great that the amount of salt or sodium sulfate used in standardizing these dyes is sufficient to give bad results on rayon, particularly in pack dyeing owing to the fact that the liquor material ratio is necessarily small. The natural salts in the water used are sufficient to affect the results." Experiments conducted in our laboratories, under the direction of W. H. Watkins, with a wide range of direct dyes dyed on cotton in water brought to 10° hardness with calcium chloride, demonstrated that no generalizations, covering direct dyes as a class, can be made as to their behavior in hard water. A number of important direct dyes give stronger dyeings in hard water than in soft; for instance, Calcodur Brown 4RL, Calcomine Blue RW, Colour Index 512, and Calcomine Fast Red 8B. Other direct dyes such as Calcomine Azurine BT, Colour Index 502; Calcomine Red FC, Colour Index 419; and Calcomine Yellow Brown K Ex., Colour Index 596, may give poor results in hard water.

The addition of a small amount of soda ash or one of the phosphate water softeners will usually correct the effect of hard water. With dyes that are affected by alkali, such as many direct blues and greens, care must be taken not to overdo the addition of alkaline softeners.

Calcomine Azurine BT is sensitive to both soda ash and to hard water. Dyed in hard water, however, with just the proper amount of soda ash it will give its normal shade and strength. When direct colors are applied in hard water, anhydrous Glauber's salt is to be preferred to common salt as an assistant. It cannot be assumed that hard water will affect a dyeing on rayon in exactly the same manner as on cotton.

Boulton and Reading[4] have shown that the dyeing rates of various direct dyes on viscose rayon varied from dye to dye between limits of 1 to more than 3,000, as expressed by the "time of half dyeing." The "time of half dyeing" is a term for evaluating their experiments on viscose rayon with direct dyes so that the dyes can be listed according to their dyeing speed and rate of exhaustion. Experiments carried out in this laboratory with Calcodurs and Calcomines on Bemberg or cuprammonium rayon show that, in general, the same principles apply to this fiber as apply to viscose rayon. It has been shown by these tests that a selection of dyes within a given class gives more level and better penetrated results than a combination of dyes selected from the two extreme classes.

It seems unreasonable to attribute all of the exhausting powers of common salt on direct dyes entirely to the making of the dye less soluble in the dyebath. Factors other than solubility must certainly have their influence in the kinetics of direct dyeing because many dyes remain in solution in the presence of high percentages of common salt.

Some dyes become considerably lighter in shade when boiled than they do when dyed at 150° F., regardless of the amount of common salt used. An example of such a dye is Calcomine Brilliant Pink SX Conc. Other dyes remain very light in shade when dyed at 75° F., regardless of the amount of common salt used; for example, Calcodur Brown 4RL. The above tests would seem to make it improbable that the only function of common salt in the dyebath is to decrease the solubility of direct dyes.

THE USE OF AMMONIUM SULFATE IN UNION DYEING

The use of ammonium sulfate in union dyeing has been standard practice in dyehouses for many years. It can be added to the dyebath, thus neutralizing the residual alkali remaining in the fabric after scouring. The pH of the dyebath is of importance because of its influence on the levelness of unions. Unequal distribution of alkali in mixed fabrics can result in very uneven shades. Some dyes also contain fixed alkali such as soda ash for solubility and blending which would be neutralized and rendered harmless by the addition of ammonium sulfate. As mentioned previously, there are times when a single cotton dye would be an exact match for the shade desired, but too often these dyes only slightly stain the wool in a neutral or slightly alkaline bath and, therefore, do not cover sufficiently to give a solid shade on wool, rayon or cotton-wool blends.

A number of direct cotton dyes which do not dye wool heavily enough in a neutral Glauber's salt or common salt bath will dye and cover the wool sufficiently if an addition of 2 per cent to 5 per cent of ammonium sulfate is made to the dyebath. The presence of ammonium sulfate will also help to exhaust neutral dyeing wool dyes and give better development of color on the wool. In many instances the boiling time can be reduced considerably, thus effecting a saving of time and steam.

Solid shades of developed blacks can be produced on wool-rayon or wool-cotton mixes with Diazo Black V types, if ammonium sulfate is added to the dyebath at the beginning of the dyeing operation. The sulfon-cyanine types of black are sometimes used to build up the depth of shade on the wool but some of these blacks have the peculiar property of turning brown when diazotized previous to developing. Therefore, they are not suitable for use in developed black combinations. An addition of 3 per cent to 5 per cent ammonium sulfate will fill up the wool so that it will not be necessary to add neutral dyeing wool blacks. The boiling time can also be considerably reduced when ammonium sulfate is used.

Some direct cotton dyes yield heavier shades on both rayon and cotton when ammonium sulfate is used. In other instances, the rayon builds up in shade at the expense of the shade on the cotton. Laboratory tests should always be made with dyes intended for use on a given fabric before ammonium sulfate is included in the formula.

GARMENT DYEING

In garment dyeing an even greater number of adverse conditions are present because of the nature of the work. The dyeing properties of wool are changed by exposure to sunlight, weather, and many other conditions. This is also true of other textile fibers. To obtain a solid shade on a worn woolen coat or suit is an art in itself, but when rayon, acetate, pure silk, cotton, or other fibers are also present and must be colored so that they cannot be seen, the art of dyeing seems to have reached a high degree of ability.

MOISTURE CONTROL AND JUDGING SHADES

It was mentioned[1, 5] that the shades of many colors dyed on wool and other fibers varied, depending upon the moisture remaining in the fiber. While this is an important factor in matching colors on a single textile material, it becomes of more importance in union dyeing. The different fibers in the union may not regain or give up the same amounts of water and may not give up or regain water at the same rate. In this way, the shade of a union dyeing will vary with the moisture content and a poor union effect is produced if one of the fibers in the union is quite different from the others in its moisture content. Thus a bone-dry sample may be entirely different in shade from a sample which has been aired and brought to the atmospheric moisture conditions. Samples being matched should be compared under similar drying or regain conditions.

CONCLUSION

In this paper some of the factors which influence the dyeing of unions have been discussed and illustrated. By microscopical examination of cross-sections made from materials dyed with various dyes and dyeing procedures, it has been possible to clarify some of the factors which enter into making union dyeing one of the most difficult of the dyeing processes. The individualities of both fibers and dyestuffs make it difficult to draw general conclusions. However, the observations explain the causes for many of the results obtained in practical union dyeing and should aid in their future study so that better and more consistent union dyeing will be obtained.

* * *

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Central Notations for

ISCC—NBS COLOR NAMES*

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Editor's Note: The American Association of Textile Chemists and Colorists has been an active member of the Inter-Society Color Council since the Council's organization in 1931, Walter M. Scott having been chairman of AATCC delegates during that time (Col. Scott is now vice-chairman of the Council). In April 1940, the Research Committee of the AATCC endorsed the ISCC-NBS method of naming colors, as has D-13 of the ASTM, "in order to promote uniformity of nomenclature in the presentation of textile color data." Consequently, the AMERICAN DYESTUFF REPORTER, of August 5, 1940, published the series of ISCC-NBS name charts (pp. 392-396). The paper published in the present issue contains central notations for these names and, with the boundaries given in the Judd-Kelly paper published by the National Bureau of Standards, provides complete data for application of ISCC-NBS color names. Central notations are requisite to the preparation of color charts which the ISCC committee hopes to make available when it becomes financially or cooperatively possible to do so. Out of 312 colors, 57 are already available, having been made up to cover the range of browns used in soil color identification.

THE problem of developing color designations "sufficiently standardized to be acceptable and usable by science, sufficiently broad to be used by science, art, and industry, and sufficiently commonplace to be understood, at least in a general way, by the whole public" was presented to the Inter-Society Color Council at its first meeting in 1931 by the Revision Committee of the *U. S. Pharmacopoeia.*

A report in 1933 *(1)*[3] of the Council's Committee on Measurement and Specification, I. H. Godlove, Chairman, provided the basis which was followed in developing what is now known as the ISCC-NBS[4] System of Color Designation. Setting boundaries for these color names proved to be the greatest problem, but in 1939 the work was completed at the National Bureau of Standards with the aid of the American Pharmaceutical Association and the U. S. Pharmacopoeial Revision Committee who for this purpose jointly supported a research associateship at the National Bureau of Standards. The Inter-Society Color Council in 1939 formally approved by letter ballot[5] and recommended to the U. S. Pharmacopoeial Revision Committee the method as described in a report by Judd and Kelly *(2)*. Delegates from the Optical Society of America were active in cooperating with those from other member bodies and with individual members in developing this method.

The method adopted is simple in principle. The terms light, medium, and dark designate decreasing degrees of lightness, the adverb "very" is added to extend the lightness scale to "very light" and "very dark." The adjectives weak, medium, strong, vivid, designate increasing degrees of saturation. In order that unwieldy adjective combinations shall not be required, the following terms have been substituted for certain descriptions:

pale as a substitute for light, weak
brilliant as a substitute for light, strong
moderate as a substitute for medium, medium
dusky as a substitute for dark, weak
deep as a substitute for dark, strong

The relationship of these adjective modifiers is shown in Fig. 1. These terms are used to modify the following hue or limited hue range names: pink, red, orange, brown, yellow, olive, green, blue, purple, and combinations of these terms formed by using two of them, as in blue green, or an -ish suffix with one, as in purplish pink. For the

very pale (very light, weak)	very light	very brilliant (very light, strong)	
pale (light, weak)	light	brilliant (light, strong)	
weak	moderate (medium lightness) (medium saturation)	strong	vivid (very strong)
dusky (dark, weak)	dark	deep (dark, strong)	
very dusky (very dark, weak)	very dark	very deep (very dark, strong)	

Fig. 1—Relation of adjective modifiers.

*Reprinted from *Journal of the Optical Society of America*, Vol. 31, No. 9, 587-591, September, 1941.

[1]Color Technologist, and Chairman of the ISCC committee to obtain central notations for ISCC-NBS names.

[2]Member of committee.

[3]Italic numbers in parentheses refer to literature cited.

[4]Initials are for Inter-Society Color Council-National Bureau of Standards.

[5]Out of 27 votes received (33 possible), 26 were for adoption. Except for one association, and one ballot marked "not voting," there were at least two affirmative votes (out of a possible 3) from each association represented in the Council at the time the vote was taken. There were no negative votes.

neutral series the terms, white, gray, and black are used.

Certain of the hue names cover all lightnesses and saturations, as in the case of green. But certain other hue names cover only a limited range of lightnesses and saturations, as the pinks which refer to very light reds, and the olives which refer to very dark yellows. But common usage is so strong in regard to such terms that the ISCC-NBS method has taken them into consideration and has applied different names to limited ranges of lightnesses and saturations of a single hue. Similarly, colors of yellow-red hue have been designated by three different hue names. The name "brown" is given to the dark group of colors, the term "orange" to those that are light and medium-to-strong in saturation, and the term "orange-pink' to those for light and weak yellow-reds. Each of the terms, brown, orange, and orange-pink is then divided into several designations by the use of appropriate modifiers selected from those shown in Fig. 1.

The color designations of the ISCC-NBS system define a block in the surface-color solid. The complete system provides for 312 such blocks, a number quite sufficient for many purposes, although it means that each block contains many distinguishable colors.

The boundaries of each designation are given in the 34 charts included in the Judd-Kelly report. For simplicity and ease of reference the limits were reported in terms of the Munsell color notation. It may be desirable ultimately to supplement this practical definition of limits for each color designation by giving equivalent definitions in terms of the standard coordinate system internationally adopted in 1931, since the standard system does not depend upon a material set of standards, as does the Munsell system. Meanwhile, interpolation curves made available by the laboratories of the Agricultural Marketing Administration[6] already permit a fairly reliable transfer from Munsell notation to ICI specification, and it is expected that conversion tables of the colors in the Maerz and Paul *Dictionary of Color* will soon be available in Munsell notation. This will enable the standard ISCC-NBS color name for any color to be found by reference to the ICI, Maerz and Paul *Dictionary*, or the Munsell system directly, through the use of published conversion tables.

Because abbreviations probably will be used more often than not for the ISCC-NBS color designations, a notation for recording them is given in Table I. Capital letters refer to the noun form of the hue name; lower case letters are used for the adjective form. Since blue, brown, and black all begin with B, they are distinguished by writing the abbreviation B for blue, Br for brown, Bk for black. Green and gray are distinguished by using G for green, Gr for gray. Orange and olive are distinguished by using O for orange, Ol for olive.

The method of designation has been described before a number of the national associations that are member bodies of the Inter-Society Color Council *(3)*[7] and subcommittees

TABLE I
Abbreviations for Use with ISCC-NBS System of Designating Colors

Noun Form of Hue	*Adjective Form of Hue*	*Adjective Modifiers*
Pk—pink	pk—pinkish	lt—light
R—red	r—reddish	dk—dark
O—orange	o—orange	wk—weak
Br—brown	br—brownish	str—strong
Y—yellow	y—yellowish	mod—moderate
Ol—olive	ol—olive	med—medium
G—green	g—greenish	viv—vivid
B—blue	b—bluish	
P—purple	p—purplish	
Wh—white		*Adverb Modifier*
Gr—gray		v—very
Bk—black		

of the Council have continued to work on various problems connected with the adoption of these color designations for, although they were officially adopted by the ISCC only for use with drugs and chemicals, other applications are being studied in the expectation that they will be adopted for more general use. The ISCC-NBS color designations are already being used in the new edition of the *National Formulary* and *U. S. Pharmacopeia*, but it will take several years before changes are made in all the monographs, since the work of measuring all the drugs and chemicals named in them is considerable.

Early in 1941 a committee on the specification and production of central colors for the ISCC-NBS color designations was appointed *(4)*.[8] Its first problem, assigned to the authors, was to obtain central notations for the color names for which boundaries had been set by Judd and Kelly, for not until these central notations are known can charts be made up to illustrate the ISCC-NBS system of names, and although these names are gradually coming into use, such use cannot be widespread until charts are available to illustrate them.

As might be expected, each central notation represents the approximate center of the corresponding block in the color solid. While some of these blocks are irregular in form, nearly always they could be divided into regular slabs. This made it possible to secure a central notation quite readily by making average determinations of hue, chroma, and value, weighted in accordance with the supporting volumes.

In Table II there are presented for the first time Munsell

[6] Dorothy Nickerson, "Use of ICI tristimulus values in disk colorimetry." Mimeographed preliminary report (1938). U. S. Department of Agriculture.

[7] In October, 1938, before the Optical Society of America (by D. B. Judd); in February, 1940, before the U. S. Pharmacopoeial Convention and National Formulary (by K. L. Kelly); in February, 1940, before the Technical Association of the Pulp and Paper Industry (by D. B. Judd); in March, 1940, before D-13 of the American Society for Testing Materials (by D. Nickerson); in April, 1940, before the Society of Motion Picture Engineers (by H. P. Gage); in September, 1940, before the Illuminating Engineering Society (by D. B. Judd); and in March, 1941, before the American Ceramic Society (by C. Robertson).

[8] Blanche R. Bellamy, Carl E. Foss, Walter C. Granville, S. M. Newhall, and Dorothy Nickerson, Chairman.

TABLE II
Munsell Notations for Central Colors of ISCC-NBS Color Names

Name	Munsell Notation of Central Color
PINKS AND REDS	
pinkish white	6.5R 9.0/1.0
pinkish gray	6.5R 7.5/1.0
reddish gray	8.5R 5.5/1.0
dark reddish gray	7.5R 3.5/1.0
reddish black	7.5R 1.5/1.0
pale purplish pink	4.5RP 8.7/3.0
light purplish pink	4.5RP 8.5/7.0
brilliant purplish pink	4.5RP 8.5/11.0
weak purplish pink	4.5RP 7.0/3.0
moderate purplish pink	4.5RP 7.0/7.0
strong purplish pink	4.5RP 7.0/11.0
pale pink	2.0R 8.7/2.8
light pink	3.0R 8.7/6.2
brilliant pink	0.5R 8.5/11.0
weak pink	3.5R 7.3/2.5
moderate pink	4.5R 7.3/5.7
strong pink	4.5R 7.8/9.7
vivid pink	6.0R 8.2/13.0
pale orange pink	2.5YR 9.0/2.0
light orange pink	2.0YR 9.0/4.8
weak orange pink	2.5YR 7.5/2.0
moderate orange pink	2.0YR 7.5/4.8
strong orange pink	1.5YR 8.5/9.0
pale purplish red	0.5R 6.0/4.0
light purplish red	0.5R 6.0/8.0
brilliant purplish red	0.5R 6.0/12.0
weak purplish red	0.5R 4.5/4.0
moderate purplish red	0.5R 4.5/7.0
strong purplish red	0.5R 4.5/11.0
vivid purplish red	0.5R 4.5/14.0
dusky purplish red	0.5R 3.0/4.0
dark purplish red	0.5R 3.0/7.0
deep purplish red	0.5R 3.0/11.0
very dusky purplish red	0.5R 1.5/4.0
very dark purplish red	0.5R 1.5/7.0
very deep purplish red	0.5R 1.5/11.0
pale red	8.5R 6.0/2.7
light red	5.0R 6.0/8.0
brilliant red	5.0R 6.0/12.0
weak red	8.5R 4.5/2.7
moderate red	5.0R 4.5/7.0
strong red	5.0R 4.5/11.0
vivid red	5.0R 4.5/14.0
dusky red	8.5R 3.0/2.6
dark red	5.0R 3.0/7.0
deep red	5.0R 2.5/11.0
very dusky red	8.5R 1.5/2.6
very dark red	5.0R 1.5/7.0
ORANGES AND BROWNS	
light brownish gray	8.5YR 5.5/1.0
brownish gray	7.5YR 3.5/1.0
brownish black	7.5YR 1.5/1.0
light reddish orange	9.0R 7.0/9.0
brilliant reddish orange	9.0R 7.0/13.0
weak reddish orange	9.5R 5.7/5.5
moderate reddish orange	9.0R 5.5/9.0
strong reddish orange	9.0R 5.5/13.0
vivid reddish orange	9.0R 5.5/16.0
dark reddish orange	9.4R 4.0/10.0
deep reddish orange	9.0R 4.0/13.0
very pale orange	9.0YR 8.5/2.0
pale orange	6.5YR 8.5/5.0
light orange	5.5YR 8.5/9.0
brilliant orange	5.5YR 8.5/13.0
weak orange	5.5YR 6.6/5.4
moderate orange	4.5YR 6.5/9.0
strong orange	4.5YR 6.5/13.0
vivid orange	4.5YR 6.2/16.0
dark orange	4.5YR 5.0/9.0
deep orange	4.5YR 5.0/13.0
pale yellowish orange	0.5Y 9.0/5.1
light yellowish orange	10.0YR 9.0/9.0
brilliant yellowish orange	10.0YR 9.0/13.0
weak yellowish orange	0.5W 7.5/5.1
moderate yellowish orange	10.0YR 7.5/9.0
strong yellowish orange	10.0YR 7.5/13.0
vivid yellowish orange	10.0YR 7.5/16.0
dusky yellowish orange	10.0YR 6.0/6.0
dark yellowish orange	10.0YR 6.0/9.0
deep yellowish orange	10.0YR 6.0/13.0
pale reddish brown	1.5YR 5.0/4.0
weak reddish brown	1.5YR 3.5/4.0
moderate reddish brown	9.0R 3.5/7.0
strong reddish brown	9.0R 3.0/11.0
dusky reddish brown	1.5YR 1.5/4.0
dark reddish brown	9.0R 1.5/7.0
deep reddish brown	9.0R 1.5/11.0
very pale brown	9.0YR 7.0/2.0
pale brown	8.5YR 5.5/2.0
light brown	5.0YR 5.3/5.0
weak brown	8.5YR 3.5/2.0
moderate brown	5.0YR 3.5/5.0
strong brown	4.5YR 3.5/9.0
dusky brown	8.5YR 1.5/2.0
dark brown	5.0YR 1.5/5.0
deep brown	4.5YR 1.5/9.0
light yellowish brown	1.0Y 6.0/4.0
moderate yellowish brown	10.0YR 4.5/5.2
strong yellowish brown	10.0YR 4.5/9.0
dark yellowish brown	10.0YR 2.5/5.2
deep yellowish brown	10.0YR 2.5/9.0
light olive brown	4.0Y 5.0/5.0
moderate olive brown	4.0Y 3.5/5.0
dark olive brown	4.0Y 1.5/5.0
YELLOWS AND OLIVES	
yellowish white	7.5Y 9.0/1.1
yellowish gray	7.5Y 7.5/1.1
light olive gray	9.5Y 5.5/1.1
olive gray	9.5Y 3.5/1.1
olive black	9.5Y 1.5/1.1
pale yellow	5.5Y 9.0/3.3
light yellow	4.5Y 9.0/7.0
brilliant yellow	4.5Y 9.0/11.0
weak yellow	5.5Y 7.5/3.3
moderate yellow	4.5Y 7.5/7.0
strong yellow	4.5Y 7.5/11.0
vivid yellow	4.5Y 7.5/14.0
dusky yellow	5.0Y 6.0/4.0
dark yellow	4.5Y 6.0/7.0
deep yellow	4.5Y 6.0/11.0
pale greenish yellow	9.0Y 9.0/4.0
light greenish yellow	9.0Y 9.0/7.0
brilliant greenish yellow	9.0Y 9.0/11.0
weak greenish yellow	9.0Y 7.5/4.0
moderate greenish yellow	9.0Y 7.5/7.0
strong greenish yellow	9.0Y 7.5/11.0
vivid greenish yellow	9.0Y 7.5/14.0
dusky greenish yellow	9.0Y 6.0/4.0
dark greenish yellow	9.0Y 6.0/7.0
deep greenish yellow	9.0Y 6.0/11.0
pale olive	6.0Y 5.5/2.5
light olive	8.5Y 5.0/5.0
weak olive	6.0Y 3.5/2.5
moderate olive	8.5Y 3.5/5.0
dusky olive	6.0Y 1.5/2.5
dark olive	8.5Y 1.5/5.0
GREENS	
greenish white	5.5G 9.0/1.0
light greenish gray	5.5G 7.5/1.0
medium greenish gray	5.5G 5.5/1.0
dark greenish gray	5.5G 3.5/1.0
greenish black	5.5G 1.5/1.0
weak olive green	4.0GY 3.5/2.0
moderate olive green	4.0GY 3.3/4.7
strong olive green	4.0GY 3.0/9.0
dusky olive green	4.0GY 1.5/2.0
dark olive green	4.0GY 1.5/5.0
deep olive green	4.0GY 1.5/9.0
pale yellow green	4.0GY 8.5/2.5
light yellow green	4.0GY 8.5/7.0
brilliant yellow green	4.0GY 8.5/11.0
weak yellow green	4.0GY 6.5/2.5
moderate yellow green	4.0GY 6.5/7.0
strong yellow green	4.0GY 6.5/11.0
vivid yellow green	4.0GY 6.5/14.0
dusky yellow green	4.0GY 5.0/2.5
dark yellow green	4.0GY 4.5/7.0
deep yellow green	4.0GY 4.5/11.0
very pale yellowish green	9.5GY 9.0/4.0
very light yellowish green	9.5GY 9.0/7.0
pale yellowish green	9.5GY 7.5/4.0
light yellowish green	9.5GY 7.5/7.0
brilliant yellowish green	9.5GY 7.5/11.0
weak yellowish green	9.5GY 5.5/4.0
moderate yellowish green	9.5GY 5.5/7.0
strong yellowish green	9.5GY 5.5/11.0
vivid yellowish green	9.5GY 6.5/14.0
dark yellowish green	9.5GY 4.0/5.0
deep yellowish green	9.5GY 4.0/9.0

TABLE II—Continued

Name	Munsell Notation of Central Color
Greens (Cont.)	
very dark yellowish green	9.5GY 2.5/5.0
very deep yellowish green	9.5GY 2.5/9.0
very pale green	2.5G 8.5/2.0
very light green	5.5G 8.5/5.2
very brilliant green	6.0G 8.5/9.0
pale green	2.5G 6.5/2.0
light green	5.5G 6.5/5.2
brilliant green	6.0G 6.5/9.0
weak green	2.5G 4.5/2.0
moderate green	5.5G 4.5/5.2
strong green	6.0G 4.5/9.0
vivid green	6.0G 5.5/12.0
dusky green	6.0G 3.0/2.0
dark green	5.5G 3.0/5.2
deep green	6.0G 2.5/9.0
very dusky green	6.0G 1.5/2.0
very dark green	5.5G 1.5/5.2
very light bluish green	10.0G 8.5/4.8
light bluish green	10.0G 6.5/4.8
brilliant bluish green	1.0BG 7.2/9.0
moderate bluish green	10.0G 4.5/4.8
strong bluish green	1.0BG 4.5/9.0
vivid bluish green	1.0BG 4.5/12.0
dark bluish green	10.0G 3.0/4.8
deep bluish green	1.0BG 2.5/9.0
very dark bluish green	10.0G 1.5/4.8
very pale blue green	2.0BG 8.5/2.0
very light blue green	5.5BG 8.5/5.0
pale blue green	2.0BG 6.5/2.0
light blue green	5.5BG 6.5/5.0
brilliant blue green	5.5BG 7.0/9.0
weak blue green	2.0BG 4.5/2.0
moderate blue green	5.5BG 4.5/5.0
strong blue green	5.5BG 4.5/9.0
vivid blue green	5.5BG 4.5/12.0
dusky blue green	8.0BG 3.0/2.0
dark blue green	5.5BG 3.0/5.0
deep blue green	5.5BG 2.5/9.0
very dusky blue green	8.0BG 1.5/2.0
very dark blue green	5.5BG 1.5/5.0
BLUES	
bluish white	6.0B 9.0/1.0
light bluish gray	6.0B 7.5/1.0
medium bluish gray	6.0B 5.5/1.0
dark bluish gray	6.0B 3.5/1.0
bluish black	6.0B 1.5/1.0
very light greenish blue	1.0B 8.5/5.0
light greenish blue	1.0B 6.5/5.0
brilliant greenish blue	1.0B 7.0/9.0
moderate greenish blue	1.0B 4.5/5.0
strong greenish blue	1.0B 4.5/9.0
vivid greenish blue	1.0B 4.5/12.0
dark greenish blue	1.0B 3.0/5.0
deep greenish blue	1.0B 2.5/9.0
very dark greenish blue	1.0B 1.5/5.0

Name	Munsell Notation of Central Color
Blues (Cont.)	
very pale blue	6.5B 8.5/2.9
very light blue	8.5B 8.5/7.0
very brilliant blue	8.5B 8.5/11.0
pale blue	6.5B 6.5/2.9
light blue	8.5B 6.5/7.0
brilliant blue	8.5B 6.5/11.0
weak blue	6.5B 4.5/2.9
moderate blue	8.5B 4.5/7.0
strong blue	8.5B 4.5/11.0
vivid blue	8.5B 4.5/14.0
dusky blue	8.0B 2.5/3.1
dark blue	8.5B 2.5/7.0
deep blue	8.5B 2.5/11.0
very pale purplish blue	6.0PB 8.0/2.6
very light purplish blue	5.5PB 7.5/7.0
very brilliant purplish blue	5.5PB 7.5/11.0
pale purplish blue	6.0PB 5.5/2.6
light purplish blue	5.5PB 5.5/7.0
brilliant purplish blue	5.5PB 5.5/11.0
weak purplish blue	6.0PB 3.5/2.6
moderate purplish blue	5.5PB 3.5/7.0
strong purplish blue	5.5PB 3.5/11.0
vivid purplish blue	5.5PB 4.5/15.0
dusky purplish blue	6.0PB 1.5/2.6
dark purplish blue	5.5PB 1.5/7.0
deep purplish blue	5.5PB 1.5/11.0
PURPLES	
purplish white	6.0P 9.0/1.0
light purplish gray	6.0P 7.5/1.0
medium purplish gray	0.5RP 5.5/1.0
dark purplish gray	0.5RP 3.5/1.0
purplish black	0.5RP 1.5/1.0
very pale bluish purple	10.0PB 8.0/4.0
very light bluish purple	10.0PB 7.7/7.0
very brilliant bluish purple	10.0PB 7.5/11.0
pale bluish purple	10.0PB 5.5/4.0
light bluish purple	10.0PB 5.5/7.0
brilliant bluish purple	10.0PB 5.5/11.0
weak bluish purple	10.0PB 3.5/4.0
moderate bluish purple	10.0PB 3.5/7.0
strong bluish purple	10.0PB 3.5/11.0
vivid bluish purple	10.0PB 3.5/14.0
dusky bluish purple	10.0PB 1.5/4.0
dark bluish purple	10.0PB 1.5/7.0
deep bluish purple	10.0PB 1.5/11.0
very pale purple	5.5P 8.5/2.6
very light purple	5.0P 8.5/7.0
pale purple	5.5P 6.5/2.6
light purple	5.0P 6.5/7.0
brilliant purple	5.0P 6.5/11.0
weak purple	5.5P 4.5/2.6
moderate purple	5.0P 4.5/7.0
strong purple	5.0P 4.5/11.0
vivid purple	5.0P 4.5/14.0
dusky purple	5.5P 3.0/2.6
dark purple	5.0P 3.0/7.0
deep purple	5.0P 3.0/11.0
very dusky purple	5.5P 1.5/2.6
very dark purple	5.0P 1.5/7.0
very deep purple	5.0P 1.5/11.0

Name	Munsell Notation of Central Color
Purples (Cont.)	
very pale reddish purple	9.5P 8.5/4.0
very light reddish purple	9.5P 8.5/7.0
pale reddish purple	9.5P 6.5/4.0
light reddish purple	9.5P 6.5/7.0
brilliant reddish purple	9.5P 6.5/11.0
weak reddish purple	9.5P 4.5/4.0
moderate reddish purple	9.5P 4.5/7.0
strong reddish purple	9.5P 4.5/11.0
vivid reddish purple	9.5P 4.5/14.0
dusky reddish purple	9.5P 3.0/4.0
dark reddish purple	9.5P 3.0/7.0
deep reddish purple	9.5P 3.0/11.0
very dusky reddish purple	9.5P 1.5/4.0
very dark reddish purple	9.5P 1.5/7.0
very deep reddish purple	9.5P 1.5/11.0
pale red purple	6.5RP 6.0/2.7
light red purple	4.5RP 6.0/8.0
brilliant red purple	4.5RP 6.0/12.0
weak red purple	6.5RP 4.5/2.7
moderate red purple	4.5RP 4.5/7.0
strong red purple	4.5RP 4.5/10.0
vivid red purple	4.5RP 4.0/14.0
dusky red purple	6.5RP 3.0/2.7
dark red purple	4.5RP 3.0/7.0
deep red purple	4.5RP 3.0/11.0
very dusky red purple	6.5RP 1.5/2.7
very dark red purple	4.5RP 1.5/7.0
very deep red purple	4.5RP 1.5/11.0
GRAYS AND NEAR GRAYS	
white	N 9.2/
light gray	N 7.5/
medium gray	N 5.5/
dark gray	N 3.5/
black	N 1.3/
pinkish white	6.5R 9.0/1.0
pinkish gray	6.5R 7.5/1.0
reddish gray	8.5R 5.5/1.0
dark reddish gray	7.5R 3.5/1.0
reddish black	7.5R 1.5/1.0
light brownish gray	8.5YR 5.5/1.0
brownish gray	7.5YR 3.5/1.0
brownish black	7.5YR 1.5/1.0
yellowish white	7.5Y 9.0/1.1
yellowish gray	7.5Y 7.5/1.1
light olive gray	9.5Y 5.5/1.1
olive gray	9.5Y 3.5/1.1
olive black	9.5Y 1.5/1.1
greenish white	5.5G 9.0/1.0
light greenish gray	5.5G 7.5/1.0
medium greenish gray	5.5G 5.5/1.0
dark greenish gray	5.5G 3.5/1.0
greenish black	5.5G 1.5/1.0
bluish white	6.0B 9.0/1.0
light bluish gray	6.0B 7.5/1.0
medium bluish gray	6.0B 5.5/1.0
dark bluish gray	6.0B 3.5/1.0
bluish black	6.0B 1.5/1.0
purplish white	6.0P 9.0/1.0
light purplish gray	6.0P 7.5/1.0
medium purplish gray	0.5RP 5.5/1.0
dark purplish gray	0.5RP 3.5/1.0
purplish black	0.5RP 1.5/1.0

notations for the ISCC-NBS central colors. Use is already being made of these notations by the publication of color charts for specifying soil colors according to the ISCC-NBS system of names *(5)*.

LITERATURE CITED

(*1*) I. H. Godlove, Report of Committee on Measurement and Specification, Minutes of 1932 Annual Meeting, I.S.C.C. News Letter No. 4.

(*2*) D. B. Judd and K. L. Kelly, "Method of designating colors," J. Research, Nat. Bur. Stand. **23,** 355 (Sept., 1939) (RP 1239, 10 cents from Government Printing Office, Washington, D. C.).

(3) D. B. Judd and K. L. Kelly, "Scientific naming of drugs," J. Am. Pharm. Assn. **27,** No. 3 (March, 1938) D. B. Judd. "The Inter-Society Color Council Tentative System of Color Names." J. Opt. Soc. Am. **29,** 142A (1939). D. B. Judd, "Systematic color designations for paper." Tech. Assn. Pap. **23,** 512-518 (June. 1940). also Paper Trade J. (October 17, 1940). p. 35. Dorothy Nickerson, "Standardization of color names, the ISCC-NBS method," 1940 A.S.T.M. Standards on Textile Materials, D-13 Manual, also Am. Dyestuff Rep. **29,** No. 16, 392-396 (August 5, 1940). K. L. Kelly. "Instructions for determining color names for drugs and chemicals." Bull. Nat. Form. Comm. **8,** 11 (1940). H. P. Gage, "Color theories, and the Inter-Society Color Council." J. Soc. Mot. Pict. Eng. **35** (October, 1940). D. B. Judd. "Color systems and their inter-relation." Illum. Eng. **36,** 3 (1941).. C. Robertson. "Color standards for opaque ceramic materials." J. Am. Ceram. Soc. **24** (1941).

(*4*) Summary of first Committee Report, Minutes of Tenth Annual Meeting of the Inter-Society Color Council (March, 1941), p. 9.

(*5*) T. D. Rice, Dorothy Nickerson. A. M. O'Neal, and James Thorp, "Preliminary color standards and color names for soils," U. S. Department of Agriculture, Misc. Pub. No. 425, September, 1941.

MEETING, PIEDMONT SECTION

THE regular Spring meeting of the Piedmont Section was held at the Sir Walter Hotel, Raleigh, North Carolina, April 20, 1942. Approximately 210 persons attended the banquet, including representatives from the N. C. State College Chapter, Members of the National Council, and the National Research Committee.

Edmund L. Lauber, of the American Viscose Corporation, read a paper on the subject of "A Short Story of Avconit No. 1," and R. W. Jacoby, of the Ciba Company, addressed the meeting on the topic of "Chemicals in Relation to the War Effort." Brief remarks were made by Thomas R. Smith, President of the National Association, Dr. Louis A. Olney, President Emeritus, and Arthur Jones, Chairman of the Philadelphia Section.

Respectfully submitted,

D. STEWART QUERN, *Secretary.*

LAPEL BUTTONS bearing the seal of the Association may be purchased, by members in good standing, from the Secretary for $1.50 each.

Applicants listed in the

UNEMPLOYMENT REGISTER

should advise the Secretary or the American Dyestuff Reporter

IMMEDIATELY

when they obtain employment

• ASST. MFG. MANAGER

The American Viscose Corporation announced recently that Clarence B. Shoemaker, plant manager of the corporation's plant at Nitro, W. Va., will assume the duties of assistant manufacturing manager of the corporation at its head office in Wilmington, Del., effective June 15. Mr. Shoemaker joined the company in 1919 as laboratory assistant at the Marcus Hook, Pa., plant, was tranferred to the Parkersburg, W. Va., plant as head of the Viscose Department when the plant began operations in 1927, and was appointed plant manager at Nitro in 1939.

Effective the same date, J. F. Murrin, viscose department assistant to the manufacturing manager at Wilmington, will become plant manager of the Nitro, W. Va., plant.

• CHICAGO HEADQUARTERS, QUAKER

Quaker Chemical Products Corporation, Conshohocken, Pa., has established new and larger warehouse and blending plant facilities in Chicago to give better service to its customers in that area.

R. L. Phillips is plant manager and the new location is: Quaker Chemical Products Corp., 9243 Baltimore Avenue, Chicago, Illinois. Telephone—South Chicago 7341.

Members of the local technical service staff are K. B. Copeland and C. O. Judd. The new plant is serving Illinois, Northern Indiana and Wisconsin.

• HOSIERY ABRASION TEST

The United States Testing Company, Inc., has developed a new Hosiery Abrasion (Wear) Tester so that hosiery can be tested for wear under moist conditions. The Abrasion (Wear) Tester was developed to measure the resistance to abrasive wear of the heels and toes of all kinds of hosiery. The hosiery is tested by mounting the toe caps or heels of the samples over a metal surface and causing it then to oscillate mechanically back and forth in contact with a wearing surface of special hosiery abrasion fabric held under constant tension. The number of strokes necessary to wear holes in the toe caps or heels is noted and recorded. In order to simulate wear under moist conditions, a wick, immersed in water, was devised and so placed that a slight contact is made between the wick and the sample at the end of every second stroke. The machine is equipped with a spring arrangement so that all test samples will be held in place at the same uniform tension.

It has been found that the presence of excess moisture in hosiery at points of

News of the Government Agencies

• ORDER M-103 AMENDED

The dyestuffs conservation order (M-103) was amended on May 26th to increase the quantity of dyes available for civilian uses.

The original order, issued March 28, 1942, prohibited the sale and use of ten dyes for civilian purposes and restricted the civilian use of all other anthraquinone vat dyes for the second quarter of 1942 to 12½ per cent of the quantity of these dyes used during 1941.

The amendment removes one of the dyes —Golden Orange G—from the prohibited list of military dyes and changes the quota basis from a percentage of only the civilian vat dyes used in 1941 to a percentage of all the vat dyes used in 1941. For example, if a manufacturer in 1941 used 500 pounds of the military vat dyes and 500 pounds of the civilian vat dyes, under the original order he was permitted to use during the second quarter of 1942 only 12½ per cent of his use of civilian vat dyes in 1941—that is 12½ per cent of 500 pounds. Under the amendment he is permitted to use for civilian purposes 12½ per cent of his total used in 1941—that is, 12½ per cent of 1,000 pounds.

Other changes effected by the amendment are:

1. One producer may sell or deliver dyestuffs to another producer without having the amount charged against his quota.

2. A person may obtain up to 25 pounds of each color for experimental purposes without having it charged against his quota.

3. Canada is exempted from the export restrictions.

4. Dye consumers are permitted to purchase military dyes from the Defense Supplies Corporation in excess of minimum working inventories.

5. A mixture does not become a military dye until it has more than 10 per cent of a military color in it. In the original order not more than 2 per cent of a military color was permitted in a mixture for civilian use.

• TEXTILE CHIEF, WPB

Henry Rose, of New York City, has been appointed Chief of the Textile, Clothing and Leather Goods Branch of the War Production Board. He succeeds Ben Alexander, who has been Acting Chief of the Branch and who now resumes his duties as Assistant Chief of the Bureau of Industry Operations of the WPB. Mr. Alexander will continue to be connected with the Textile Branch in a supervisory capacity.

For the past 13 years Mr. Rose has been president and director of the Henry Rose Stores, Inc., New York City, which operates women's and children's outer wear apparel departments in some Sears, Roebuck & Co. stores throughout the country. Prior to that he was president of Henry Rosenzweig, Inc., manufacturers of women's and children's clothing.

• REGIONAL DIRECTOR, WPB

Appointment of John P. Maguire, president of the John P. Maguire Company, commercial textile factors of New York, as Regional Director of the War Production Board for New York State and northern New Jersey, was announced recently. Mr. Maguire assumed his duties May 18.

Establishment of a regional office in New York is part of the War Production Board's policy to decentralize operations. Under a recent order of the Chairman, all field offices of the WPB have been made directly responsible to the regional offices. This process of decentralization was designed to put the operations of the WPB on a local level, enabling business men to conduct their Government contacts in cities near their homes as much as possible.

Mr. Maguire is the seventh Regional Director to be appointed in the establishment of the regional offices. Other Regional Directors are: Ernest C. Kanzler, Detroit; Orville H. Bullitt, Philadelphia; Frank H. Neely, Atlanta; Joseph Overlock, Chicago; John C. Virden, Cleveland, and Walter H. Wheeler, Jr., Boston.

The office which Mr. Maguire will head is located in the Chanin Building, 122 East 42nd Street, New York City. It will be responsible for the administration of all War Production Board field offices in New York and northern New Jersey.

• RE-NEGOTIATION OF GOVERNMENT CONTRACTS

To promote spread of orders, speed in delivery and wider use of existing facilities, the War Production Board has issued Directive No. 3, providing for the renegotiation of government contracts of the "open-end" type used in peacetime.

These contracts require a government agency to purchase all of its requirements of a specified article from one company over a definite period of time.

In some cases, wartime needs for articles which the government has agreed to purchase from one company under an "open-end" contract far exceed the amounts contemplated when the contracts were orig-

inally signed, and participation of other companies is desirable both to obtain faster delivery and to use facilities of smaller companies which might otherwise go unused.

Most of these contracts have been entered into by Treasury Procurement. Contracts of the War Department, Navy Department, Maritime Commission, or any Government corporation are excluded from the terms of the directive.

• WAR PRODUCTION DRIVE

Lessing J. Rosenwald, Chief of the Bureau of Industrial Conservation, recently congratulated the War Production Drive Committee of the Grasselli, N. J., plant of E. I. du Pont de Nemours Co. on its report of an outstanding salvage campaign.

Mr. Rosenwald wrote the joint labor-management committee:

"My attention has just been called to the salvage record established by your War Production Drive Committee. Please accept my congratulations for an achievement that sets a splendid example to industrial plants of America."

The labor-management committee reported that the salvage campaign in one month netted the following materials:

105.5 tons of scrap iron
9.5 tons of hard lead
5.25 tons of copper
3. tons of brass
1.75 tons of aluminum
1.75 tons of stainless steel
.25 ton of Monel

In addition, receptacles for rubber placed throughout the plant gathered 1,073 pounds of scrap rubber.

• WOOL CONSERVATION PROGRAM

The Dar Department announced recently the appointment of a committee of experts to study all types of wool fabrics and wool substitutes in connection with the Army's wool-saving campaign.

Chairman of the committee is Dr. Milton Harris, technical director of the Textile Research Institute, Washington, D. C. Other members are Ames Stevens, of North Andover, Massachusetts, wool consultant to the War Production Board, and Colonel Max Wainer, of the Quartermaster Corps.

The committee will begin its studies immediately. The objective, Major General Edmund B. Gregory, the Quartermaster General, explained, will be the determination of the extent to which wool can be conserved without deviating seriously from existing standards of clothing and equipage.

The findings of the committee, General Gregory said, will be used as the basis for possible modifications of present specifications as necessitated by the wool shortage.

• APPOINTED TO WPB

Edwin B. Murphy, of Minneapolis, has been named Chief Business Specialist in the Purchases Division of the WPB, in charge of Textiles. Mr. Murphy was general manager of the Fairchild Sportswear Company, Minneapolis. From 1935 to 1940 he was President of Cartwright Juniors, apparel manufacturers in Minneapolis. Earlier, he practiced law in Chicago and Minneapolis.

wear decreases the resistance to abrasion to a noticeable degree.

It is stated that this new test will enable a more accurate study of the wearing properties of substitute yarns. Some yarns, because of their smooth surfaces, have very good resistance to wear in the dry state, but have only fair resistance to abrasion under moist conditions. The knowledge of the wear resistance of new yarns under both moist and dry conditions will enable the manufacturer to know which substitute is best for use.

• ACETATE RAYON COLORS

The Bernard Color & Chemical Corporation, 333 Hudson St., New York City, announces the development of a new method of producing a complete shade range on acetate rayon without the use of anthraquinone derivatives.

It is claimed that the method developed makes it possible to produce most shades including blues, aquas, greens, browns, violets, etc.

A booklet is in preparation showing shades it is possible to obtain without the use of any anthraquinone derivatives, and formulae and procedure are given.

Copies are available upon request to firms engaged in dyeing acetate rayon.

• BOOKLET ON RAYON HOSIERY

A new booklet, "How To Get the Most From Your Rayon Stockings," has just been issued by the American Viscose Corporation, 350 Fifth Avenue, New York, and copies can be obtained by writing to them.

The booklet tells how to select, wash and care for the new rayon stockings to obtain the longest wear and greatest satisfaction and describes briefly the research work being carried on to help hosiery manufacturers create rayon stockings of superior quality. An additional section tells how to specify the weight of sheerness you desire in rayon hosiery. This section compares the familiar terms used to define the sheerness of silk stockings, such as 2-thread, 3-thread, and so on, with the term "denier," which is used to define the size and weight of rayon hosiery yarns. Thus, 50-denier rayon stockings are comparable with 3 to 4 thread silk stockings, 75 denier rayons with 5 to 6 thread silk hosiery, and so on.

• RESIGNS FROM HOUSATONIC

Richard J. Reynolds has severed his connections with the Housatonic Dyeing and Printing Co., Derby, Conn. He was formerly chief colorist, superintendent of printing, and secretary of this company.

• 1942 FALL RAYON CARD

The regular edition of the 1942 *Fall Rayon Card*, the first of its kind ever issued by the organization, has just been released by The Textile Color Card Association to its members. Up to this time, the shades in the regular season card have been portrayed in silk.

Thirty colors are shown in this new card, which continues the theme of *United Victory Colors*, first introduced when the woolen collection was recently issued. Each of the shades is adapted to all rayon, rayon and cotton mixtures and cotton. The colors were passed upon by the Association's Dyestuff Advisory Committee and are in accordance with its policy of assisting the government in conserving dyestuffs required for the war program.

• T.R.I. OFFICERS

The election of Edward T. Pickard as treasurer, and of Fessenden S. Blanchard as executive secretary in addition to president, was announced by the Textile Research Institute, Inc., following a directors' meeting recently held at the Hotel Roosevelt, N. Y.

The new arrangement followed the request of Mr. Pickard who has found it necessary, because of continued ill-health, to devote only a part of his time to active business. However, his continuance as executive secretary of the Textile Foundation, plus his association with the Institute as treasurer and member of the executive committee, insures the maintenance of his close identification with, and interest in, the whole textile research movement. It also insures the continuation of the close working arrangement between the Institute and the Foundation.

Mr. Blanchard will give his full time to his work with the Institute as president and executive secretary. He is tendering his resignation to the War Production Board, and will take up his duties at the headquarters of the Institute, 10 East 40th Street, New York, on July 1.

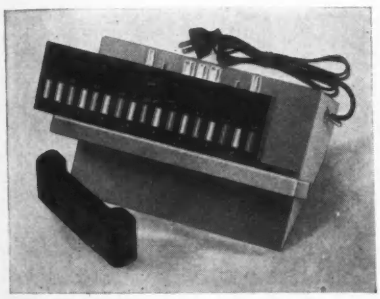
In view of the decision of the Institute and of the Foundation to adapt their research

work to the war program which resulted in the organization of the Textile Research War Council, Mr. Blanchard's consent to serve in a full time capacity with the Institute comes at a particularly fortunate time. Blanchard's intimate association with all branches of the textile work of the War Production Board over the past six months, together with the contacts established with individuals in the Government and in industry, will enable him to continue his important work with the war program.

Harold DeWitt Smith, who has been treasurer of the Institute, was elected vice-president. Fuller E. Callaway, Jr., and Dr. Robert E. Rose are also vice-presidents. These officers, with the following chairmen of the standing committees, comprise the executive committee: W. D. Appel, Stanley B. Hunt, and Douglas G. Woolf.

• MIDGET DALITE LAMP

While this lamp was designed for use with single Taylor Slide Comparators when determinations must be made at night or in dark places, it has been found to be ideal for all routine testing even in daylight.



The Comparator base sits on the shelf at an angle of 45° so that, in making readings, one can look directly into the slots in the slide and base. This eliminates handling the outfit, with possible chance of breakage, as only the sample tubes need be handled. Also, in many laboratories and plants, it is almost impossible to obtain a clear daylight background because of walls, trees, etc. The lamp is said to give uniform dalite conditions at all times. It is fitted with a Dalite glass, special bulb, cord and switch and operates on any 110 V. circuit. It can be used with any Taylor pH, Chlorine or Phosphate Comparator. Full information may be obtained from W. A. Taylor & Co., 7300 York Road, Baltimore, Md.

• MATHIESON BOOKLET

Commemorating its fiftieth anniversary, the Mathieson Alkali Works, Inc., has published a 48-page booklet entitled "Fifty Years of Chemical Progress."

The booklet traces the growth of the Mathieson organization and describes the company's major developments, which include the introduction of liquid chlorine and synthetic ammonia, the preparation of new chlorine carriers, bleaching agents, and detergents, and the production of alkalies of an exceptionally high degree of purity. Numerous illustrations show the scope of the company's present operations.

Copies of the booklet can be obtained, as long as the limited supply lasts, by mailing requests to the Mathieson Alkali Works, Inc., 60 East 42nd Street, New York City.

• REORGANIZATION, GENERAL ANILINE

Under the new management of General Aniline & Film Corporation, appointed about three months ago by the Alien Property Custodian and the Treasury Department, a complete reorganization of the company's affairs has been effected and its operations largely converted to war production. The new management, under Leo T. Crowley, Alien Property Custodian, consists of well-known engineers and industrialists.

At Binghamton, New York, the company's Ansco camera plant, heretofore engaged in the production of cameras, is now almost wholly given over to the manufacture of sextants, fuses, airplane parts and other war material. According to Albert E. Marshall, Vice-President, who is directing Ansco's activities, production will steadily be expanded to handle existing war contracts, and working personnel will be doubled.

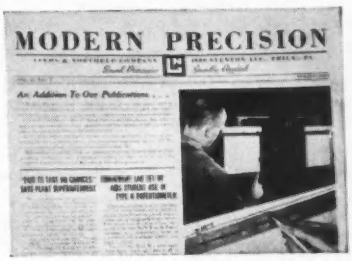
An important item in the company's Ansco operations is the manufacture of the Ozalid machine for the speedy reproduction to scale of engineering drawings and other records. Output of these machines is now going largely to the Government and to the engineering departments of airplane and tank plants and other armament concerns. Thomas E. Brittingham, Jr., is directing the Ozalid operations.

General Aniline & Film has dye-making plants at Rensselaer, New York, and Linden, New Jersey. It is stated that most of its products are now entering into the production of dyes used in the manufacture of uniform cloth, tent cloth and other textiles required by the Army and the Navy. In this connection it is noted that over 90 per cent of its vat dyes are being used for these purposes, and similarly large proportions of its output of wool dyes and sulfur colors.

General Aniline & Film is also a large producer of one of the compounds entering into the production of tetryl, a prime military explosive. The company is said to be the largest producer among the United Nations of carbonyl iron powder, of vital importance in the manufacture of wired and wireless communication apparatus.

• MODERN PRECISION

Leeds & Northrup Company has just issued a publication of general interest to engineers, research scientists, executives and users of electrical instruments, controls and furnaces.



Called "Modern Precision," it contains news of L&N instruments, controls and heat-treating methods, and of the jobs they are doing in industry, in research laboratories and in teaching and testing. An addition to other L&N literature, it supplements the regular catalogs, bulletins and circulars which will continue to be issued as before.

"Modern Precision" contains valuable information for a wide variety of industrial, educational and scientific fields. A copy can be had upon request to Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.

• TEXTILE WAR RESEARCH

A plan of action for the recently organized Textile Research War Council was outlined at a meeting recently held at the Hotel Roosevelt, New York, at which technicians representing all branches of the textile industry met with leaders of the Army, Navy and other Government agencies involved in textile purchasing, and with representatives of the Textile Research Institute, Inc., and the Textile Foundation, co-sponsors of the plan. The technicians had been delegated by associations representing all major branches of the industry. The War Council itself was organized by those associations at a meeting about a month ago.

Specific subjects for quick and timely research to solve problems created by the war emergency were suggested by the various technicians and were discussed frankly. This is the first of three stages of the job, the other two being to determine what is being done on these problems and to decide what are the gaps which need particular attention.

In the prosecution of research work on those gaps, the Textile Research War Council is in a position to offer the aid of

14 research men of the Textile Foundation at the Bureau of Standards in Washington, the research facilities of individual mills identified in the movement, and the help and advice of the executives of the textile associations.

• BOTANY PAYROLL SUBSCRIPTIONS

In an impressive ceremony attended by representatives of the Government, finance, industry, and the retail trade, foremen and supervisors of the 6,500 employees of the Botany Worsted Mills, Wednesday, May 20th, pledged subscriptions to War Savings Bonds which will exceed the existing subscriptions that now average ten per cent of the mill's payroll. Subscriptions at the beginning of the second of two twenty-five week payment periods now include over ninety-nine per cent of the employees, who have purchased approximately $600,000 worth of bonds. The occasion was the annual dinner of the Foremen's Association at the mills in Passaic, New Jersey.

Dr. Andrew McBride, President of the Paterson Savings Institute and Chairman of the Passaic County War Savings Staff awarded the mills a certificate and flag for outstanding employee participation in War Savings Bond purchases. The presentation was made to Colonel C. F. H. Johnson, President of the mills, who in turn gave them into the keeping of a committee of foremen and workers headed by Joseph S. Frauenberger, President of the Foremen's Association.

• NOPCO 15-YEAR CLUB

Simple ceremonies, in keeping with the atmosphere of war-time bustle at the plant, marked the induction of 18 new members into the "NOPCO 15-Year-Club" by Charles P. Gulick, president and chairman of the board, of National Oil Products Company, on May 19th.

The 1942 Class was the largest ever inducted into the club, which is limited to employees who have been with the firm 15 years or more. The 18 new members swelled the total membership to 68.

In presenting solid gold emblems, bearing the company trade mark and the club's name, to each of the new members, Mr. Gulick emphasized America's great need in these trying times for the kind of loyalty, hard work and initiative displayed by members of the club.

The new members just inducted into the club included Perc S. Brown, vice-president; Leslie M. Brown, A. Victor Jay, George H. Faux, Charles J. Kenlan, Frank E. Knab, Williams E. McGarry, James Bremner, Robert F. McClellan, Meyer Yablonsky, John Goeller, Nicholas Kasmiryk, Addison Wilson, Robert Jackson, Charlotte Williams and John Mobley. Two others, Miss N. O'Neill and L. D. Cook, who are employed in a company subsidiary, Brown-Jenkin & Co., Seattle, Wash., were unable to attend the ceremonies but were inducted "in absentia" by Mr. Gulick, who founded NOPCO 34 years ago.

Mr. Gulick announced that the policy of giving an extra week's vacation to all new members of the "15-Year-Club" would be continued this year, as in the past, but added that those employees who felt they could help the country's war effort most by remaining at their work would receive an extra week's salary in war bonds.

• COMMENCEMENT, N.C.S.C.

Putting its full power behind the war effort, North Carolina State College moved shortly after December 7 to speed up its program for turning out textile graduates, engineers, reserve officers, and agriculturists. Commencement was advanced from June 8 to May 9.

Josephus Daniels, Secretary of the Navy 1913-21, Ambassador to Mexico 1933-42, and a long time friend of the institution, was the principal speaker. Following his address 56 young men who had completed the requirements of the Textile School were awarded degrees. The following were awarded the degree of bachelor of science in textile chemistry and dyeing:

George Brandt, Thomas Porter Caldwell, Ye-Sun Coln Ding, George William Funderburk, Jr., Robert Joseph Granger, Harry Glover Hodges, Jr., Robert Clifton Leak, William Simpson Pearson, Thomas Joseph Sarandria, George Reece Sedberry, Jr., Carl Diedrich Sickerott, Lonnie Lee Trexler, Boyd Franklin Vaughan.

The degree of master of science in textile chemistry and dyeing was awarded to Dan Moss and Charles Kenneth Watson.

Twenty-one of those who received bachelor's degrees qualified for commissions as second lieutenants in the Officers' Reserve Corps and will shortly enter the armed services of the country. Several more have been commissioned as ensigns in the Navy. Dr. Thomas Nelson, Dean of the Textile School, said that requests for this year's graduates considerably exceeded the number in the graduating class, but he expected the large majority of this year's class to be in military service within the next few weeks, as a number of those who do not have commissions in the Army or Navy plan to enlist in some branch of the service.

• NEW HOSIERY FINISH

Burkart-Schier Chemical Company of Chattanooga, Tennessee, has perfected a special finish for cotton lace and mesh hosiery—their Hosiery Finish P-5. It is stated that this finish for cotton hosiery has met with good acceptance. It is said to be effective and economical and to cost only one-third of a cent per dozen to apply. No special equipment is needed and it is applied in the last bath. It is claimed that Finish P-5 greatly improves the appearance of cotton hosiery. It is reported that boarding and pairing are made easier as the hosiery does not curl or wrinkle. Finish P-5 does not change the shades and is said to add sales appeal to the cotton lace and mesh hosiery.

• CLASSIFIED ADVERTISEMENTS •

POSITION WANTED: Hosiery dyer for past sixteen years on pure silk, cotton, rayon, nylon and mixed fibers, with large hosiery mill in south as head dyer. Capable of handling large production, willing to go anywhere, best reference. Member of American Association of Textile Chemists and Colorists. Write Box No. 355, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Textile Chemist. Thorough experience in all phases of textile processing and application of all types dyestuffs. Have specialized in plant control, trouble diagnosis, process development, research. Desire connection with progressive organization. Married. Employed. Write Box No. 381, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Practical bleacher, dyer, finisher of cotton piece goods, art silk, staple cotton, cheeses, at present superintendent mill Latin America. English, U.S.A. and Canadian experience. Age 45. Write Box No. 382, American Dyestuff Reporter, 440 Fourth Ave.

CHEMICAL EXPERT WANTED to take care of the dyeing and finishing section (silk, rayon, wool, cotton, etc.) of a textile plant in Venezuela. Write stating experience in both chemical and mechanical side of job, age, salary desired, references, nationality, to M. Castellvi, 150 Broadway, New York, N. Y.

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In a nutshell, that is what Sandoz offers you . . . expert chemical analysis *plus* specialized products designed to meet the most exacting requirements of your operating conditions. These products have been developed by working closely with weavers, scourers, dyers and finishers.

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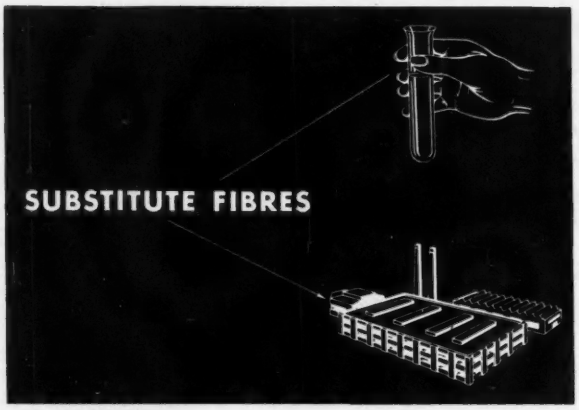

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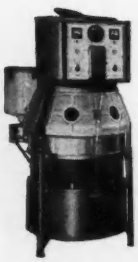

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Under these conditions the Textile Industry is fortunate in having available the Atlas Fade-Ometer and Atlas Launder-Ometer, laboratory testing instruments which make possible quick determinations of the effect of sunlight and washing.

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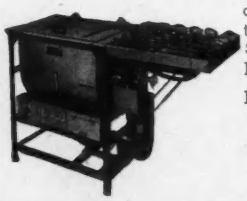

It's important to get the facts on the ıtest Atlas-Ometers if you are conerned with production or use of dyed ɹxtiles.

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Keep war production moving by keeping your stainless steel equipment at top efficiency Regardless of the solution you use, clean your equipment thoroughly at least once a week. Drain it, wash with hot water and dry with an air hose, or brush the bottom as free of water as possible and then let it dry. This is your duty under the all-out war production program.

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SPECIALISTS IN THE MANUFACTURE OF STAINLESS STEEL DYEING EQUIPMENT

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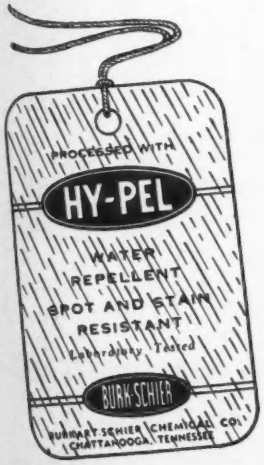
WATER REPELLENT

for



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RAYONS
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Hy-Pel treated fabrics are water repellent. They also resist spotting, staining and perspiration. The Hy-Pel process does not affect the appearance, texture or porosity of the fabric. Hy-Pel is a one bath water repellent and is applied on the quetch, padder, jig or beck. Efficient-Economical-Durable.

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8 STAR PROCESSING PRODUCTS

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Highly effective anti-fume agent for dyed acetate fabrics, possessing excellent softening and finishing properties.

★ **CULOFIX***
Used as an after treatment to prevent bleeding in water of substantive dyeings on cottons, silks and rayons.

★ **PARAMINE***
Imparts a superbly soft, full, silk-like finish to viscose and acetate fabrics and spun rayons.

★ **TETRANOL***
Rapid and positive penetrant for use in all dyeing operations and with every type of dyestuff to improve penetration of the color and produce a level shade throughout the material being dyed.

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For silk and rayons: a boil-off and scouring agent. For wool: a penetrant for fulling, scourer and soap assistant. For hosiery: a neutral scouring agent used in processing and dyeing hosiery made from mixed fibres or containing a dyed acetate stripe.

★ **AQUAROL***
A water-repellent known throughout the textile industry for its effectiveness on all types of fabrics.

★ **PERMOLITE***
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Permits positive shrinkage control and produces a soft full hand and a pleasing finish.

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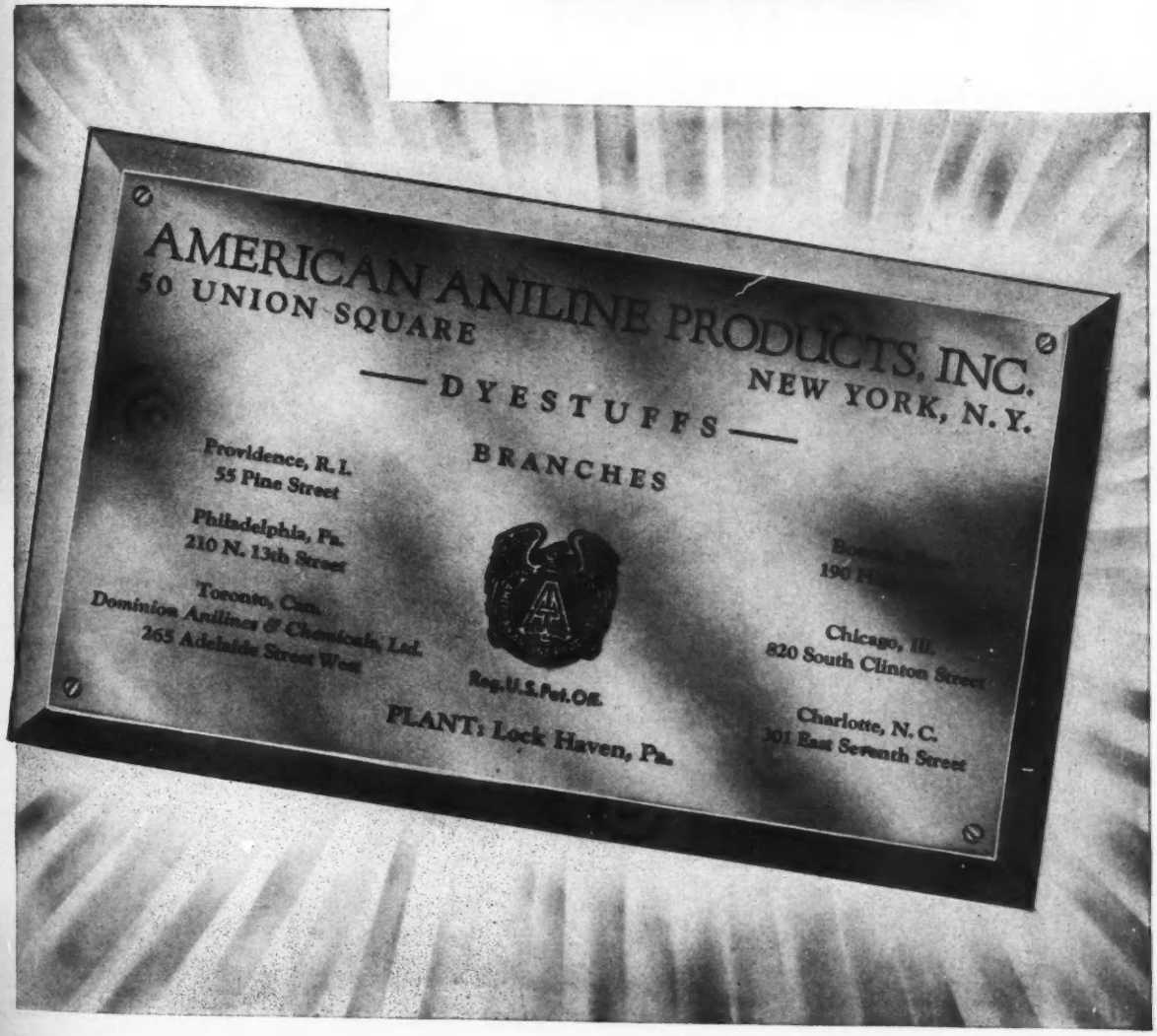

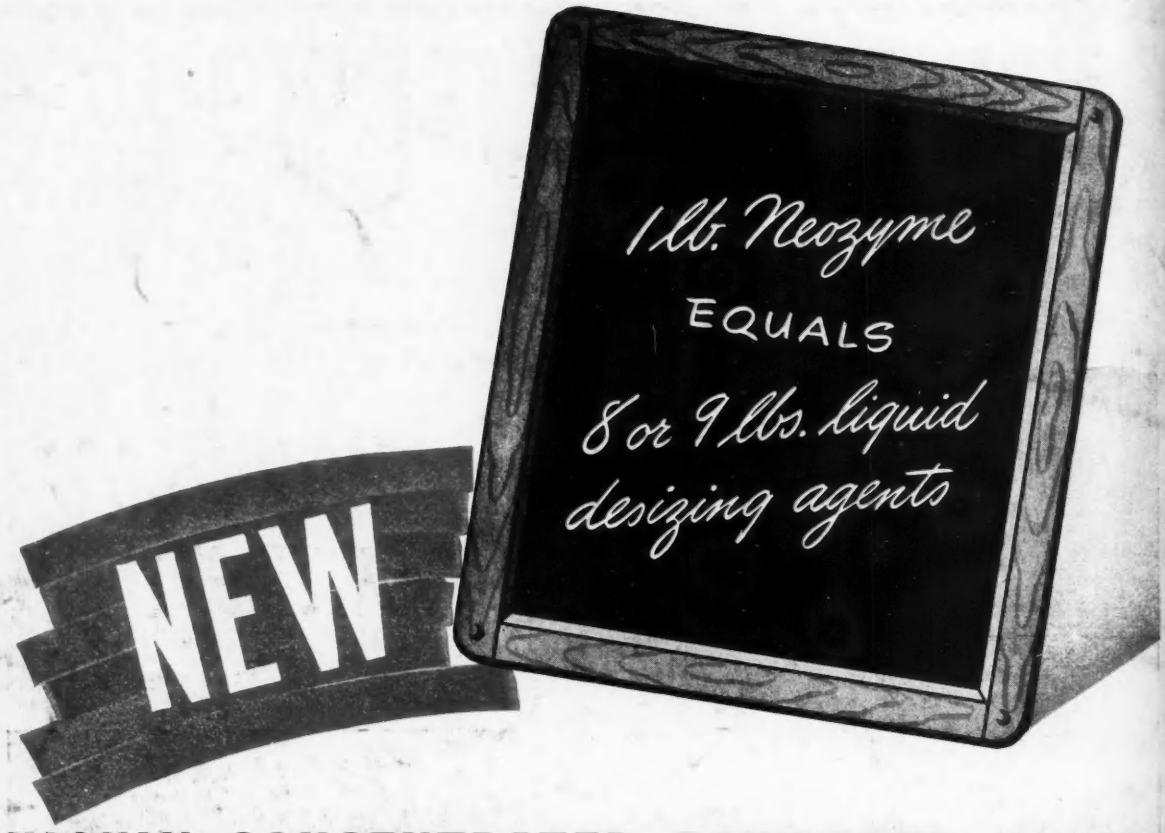

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Time: 30-45 Minutes

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